INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

C-O-N-F-I-D-E-N-T-I-A-L

25X1

COUNTRY USSR

REPORT

SUBJECT Operations Manuals for a Soviet Motor Roller, D-211 and Electrocardiographic Equipment.

DATE DISTR. 14 October 1959

NO. PAGES 1

REFERENCES RD

DATE OF INFO.

PLACE & DATE ACQ.

25X1

OK 10 80

25X1

APPRAISAL OF CONTENT IS TENTATIVE.

Attached are an operations manual for a Soviet motor roller, model D-211, in English, and a part of a manual, in Russian, apparently on electrocardiographic equipment. The booklets are UNCLASSIFIED when detached from this report.

25X1

C-O-N-F-I-D-E-N-T-I-A-L

25X1

STATE		ARMY		NAVY		AIR		FBI		AEC					

(Note: Washington distribution indicated by "X"; Field distribution by "#".)

MOTOR ROLLER
Model Д-211

OPERATION MANUAL

VSESOJUZNOJE OBJEDINENIJE
"TECHNOPROMIMPORT"
MOSCOW

Sanitized Copy Approved for Release 2010/06/11 : CIA-RDP80T00246A051100140001-8

MOTOR ROLLER

Model Д-211

OPERATION MANUAL

VSESOJUZNOJE OBJEDINENIJE
"TECHNOPROMIMPORT"
MOSCOW

Sanitized Copy Approved for Release 2010/06/11 : CIA-RDP80T00246A051100140001-8

CONTENTS

Vneshtorgizdat. Order No 034/53

APPLICATION

The Model Д-211 10-ton, 3-wheel Motor Roller is intended for compacting various types of road surfaces and their bases: crushed rock highways, cobblestone pavements, gravel roads, broken-stone bases, asphalt surfaces, retread bituminous and penetration low-cut roads, etc.

For rolling high-class pavements 10-ton rollers, which are of the heavy-grade type, are usually used along with 5-ton rollers, the latter fulfilling primary compaction (when using machines for placing asphaltic concrete with compacting rods 5-ton rollers are not necessary as primary compaction is carried out by the machine). In case of high-quality requirements for the pavement special rollers are used for waveless rolling after the passage of the 10-ton roller.

Notes: 1. When choosing the roller type it is necessary to take into account the physical properties of the material to be compacted in order to prevent its destruction.

2. When using rollers for rolling cobblestone pavements, crushed rock highways and bases, etc. the surface of the rolls undergoes intensive wear and becomes deformed making the rolls of little use for rolling of asphaltic concrete surfaces; therefore these operations call for special rollers to be employed.

SPECIFICATIONS

Total weight of roller, kg	10000
Width of strip rolled, mm	1800
Specific pressure per lin. cm of roll width, kg per cm:	
front roll	32
rear rolls	68
Diameter of rolls, mm:	
front roll	1000
rear rolls	1600
Width of rolls, mm:	
front roll	1000
rear rolls	2×500
Overlapping by rear roll traces the trace of the front roll, mm	2×100
Mean swinging radius, mm	4500

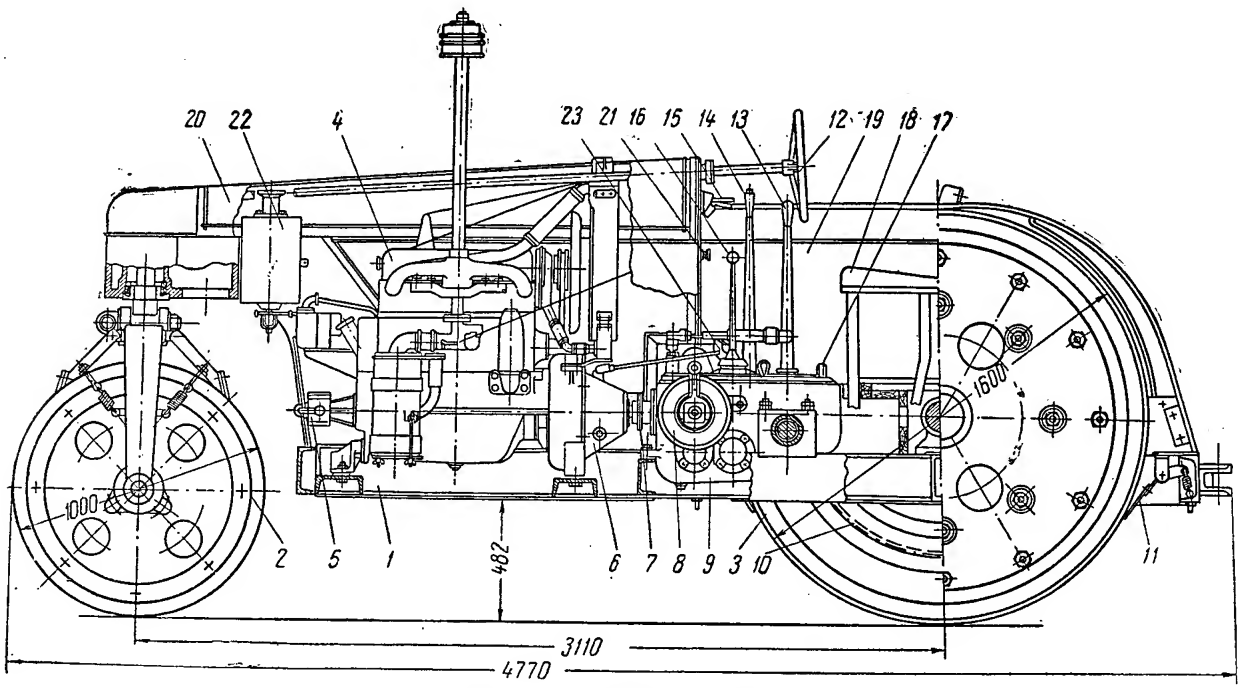

Fig. 1. General View of Roller

1. Frame; 2. Front roll; 3. Rear roll; 4. Engine; 5. Starting gear; 6. Clutch; 7. Expansion coupling; 8. Reversing gear; 9. Gear-box; 10. Side transmission; 11. Rear roll scrapers; 12. Steering wheel; 13. Reversing gear lever; 14. Brake lever; 15. Throttle control; 16. Gear shift lever; 17. Differential lock lever; 18. Seat; 19. Side pockets; 20. Hood; 21. Choke control; 22. Fuel tank; 23. Clutch pedal.

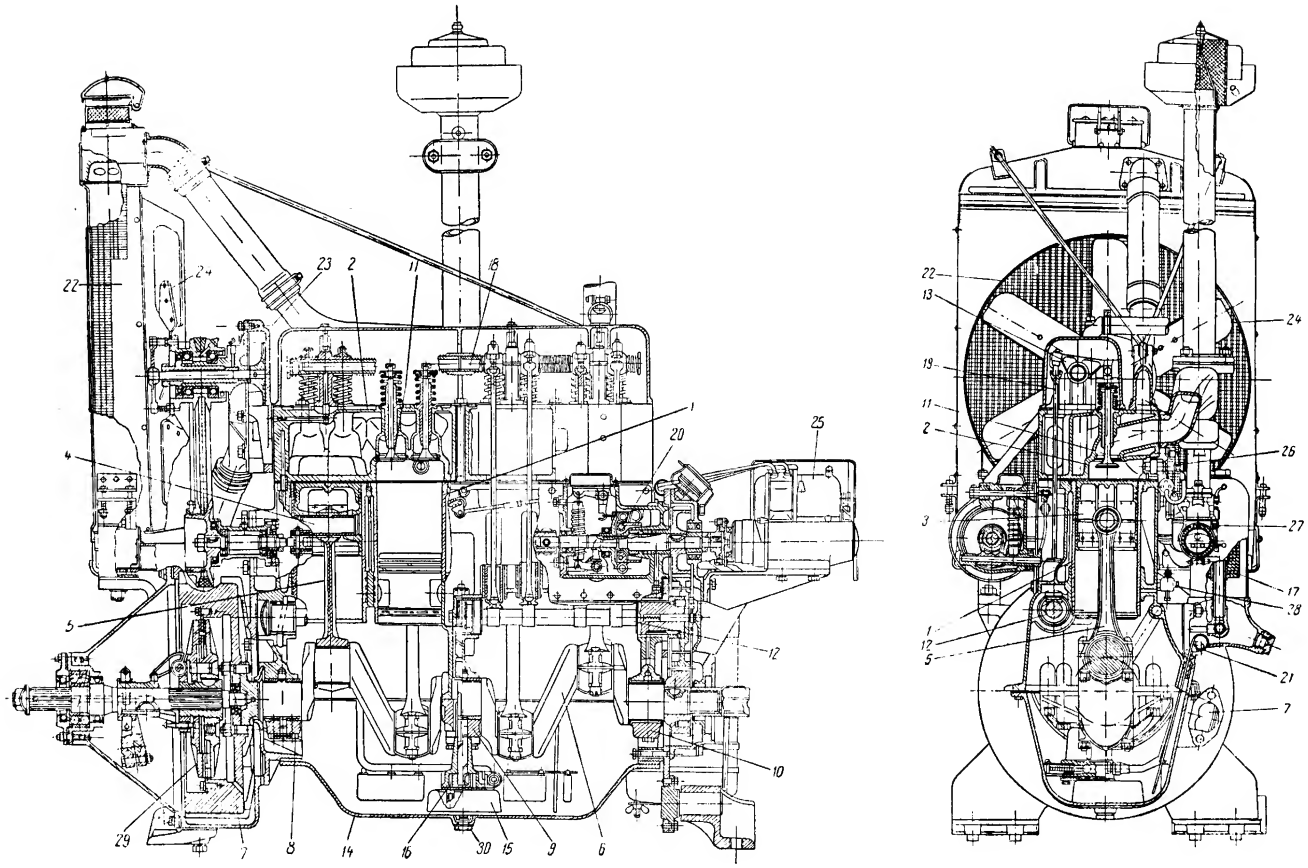

Fig. 2. Design of Engine

1. Engine cylinder sleeve; 2. Cylinder head; 3. Piston; 4. Piston pin; 5. Connecting rod; 6. Crankshaft; 7. Flywheel; 8—9—10. Crankshaft main bearings; 11. Valve; 12. Camshaft; 13. Valve rocker-arm; 14. Crank case; 15. Oil pump gauge filter; 16. Oil pump; 17. Felt filter; 18. Valve rocker-arm axle; 19. Lifter rod; 20. Centrifugal governor; 21. Oil level gauge; 22. Radiator; 23. Water pump; 24. Fan; 25. Magneto; 26. Spark plug; 27. Carburetor; 28. Drain cock; 29 Clutch plates; 30. Crank case plug

Base (distance between roll axles), mm	3100
Road clearance, mm	488
Travelling speed (front and base), km per hr:	
1st	1.8
2nd	2.2
3rd	4.0
Overall dimensions, mm	
length	4770
width	1820
height	2500
Engine:	
type	Carburetor, У-5МА
number of cylinders	4
compression ratio	4.54
cylinder bore, mm	110
piston stroke, mm	120
maximum horsepower	40
speed at maximum horsepower, r.p.m.	1400
fuel	automobile benzine
fuel consumption, g per h. p./hr	280—300
cooling system capacity, l	28
fuel system capacity, l	50
lubrication system capacity, l	8
weight of dry engine, kg	450

DESIGN OF ROLLER

The roller is a self-propelled machine driven by an internal combustion engine.

The roller (Fig. 1) consists of the following main units and gears: power equipment, transmission, control gears, compaction rolls which are the working organs and frame on which all main units are mounted.

The rolling is carried out by the rolls of the roller which serve at the same time as its running gear. The frame of the machine together with the engine mounted on it and the transmission between the engine and drive rear rolls are supported by the rolls. A three-speed gear box and reversing gear are installed on the roller so as to allow to shift smoothly roller travel from front to back speed disregarding the speed of the roller. The operator's seat is situated in the rear part of the roller. All control levers and pedals are situated here as well.

The Model Д-211 Roller has been designed with a view to modernizing the previously produced 10-ton Rollers Models Д-86 and Д-176 and essentially differs from the latter models by its more powerful engine as well as by changes made in the design of several units of the transmission and controls.

Engine. A four-stroke, four-cylinder benzine internal combustion engine (Fig. 2) is installed on the roller.

The engine cylinders are vertical, situated in one row cast in one block together with the top half of the crankshaft casing. The inserted cylinder sleeves are made of chrome-nickel alloy cast iron with a Brinnell hardness of 200—240.

The cylinder head *2* is removable, mutual for all four cylinders with compression chambers of the semi-vortex type and made of the same aluminium alloy as the engine block.

The piston *3* is made of chrome-nickel alloy cast iron. On the piston there are three compression piston rings and one oil ring. The clearance between the piston and the cylinder sleeve is 0.1—0.13 mm.

The piston rings are made of special cast iron. Their hardness by Rockwell (scale B) is 95—103. The rings have slanted joints. The gap in the joint for a new ring placed in the cylinder should be within the range of 0.2—0.54 mm. Rings placed in piston grooves should have a clearance across the height of the groove within the range of 0.025—0.07 mm.

The piston pin *4* of the floating type is hollow, of chrome-nickel steel. The pin is held against axial play by two stop rings placed in piston slots. The external surface of the pin is cemented to a depth of 1.0—1.3 mm and is hardened to 75—85 by Shore.

The connecting rod *5* is of double-T section, the bottom end being directly coated with white metal, split, with shims of 0.05 mm; the top end has a pressed-in bronze bushing.The radial clearance between the crankshaft pin and the connecting rod end should be between 0.03 and 0.069 mm. The end clearance is between 0.2 and 0.46 mm. Connecting rod bolts are made of chrome steel, grade 40X heat-treated to a hardness of 25—30 by Rockwell (scale C).

The crankshaft *6* is stamped of steel, grade 45, and is heat-treated to a hardness of 241—277 by Brinnell. The crankshaft has three main and four connecting rod pins and a flange for fastening the flywheel.

On the surface of flywheel *7* at the engine side there are marks: BMT — top dead centre; M3 — ignition point; OBC — time of opening of the first cylinder inlet valve; OBX — time of opening of the first cylinder exhaust valve.

The main bearings *8*, *9*, *10* of the crankshaft are of the sliding type with steel bushings covered with white metal 1 mm thick. The clearance between the crankshaft pin and the bushings is between 0.3—0 075 mm.

The distribution is of the valve type with top suspended valves *11*. The camshaft *12* is driven by the crankshaft *6* through spur gears with helical teeth. The camshaft is situated inside the crank case in three bearings with white metal.

Timing

Inlet valve:

opening begins 5° after top dead centre;
closing terminates 35° after bottom dead centre.

Exhaust valve:

opening begins 30° before bottom dead centre;
closing terminates at top dead centre.

The engine firing order is 1—3—4—2.

The clearance between valve *11* and rocker-arm *13* for a warmed engine is 0.3 mm.

The engine is supplied with fuel by means of the carburetor K-14A, into which fuel flows from the fuel tank by gravity. A settling basin for water is placed between the tank and the carburetor *27*.

Air sucked into the carburetor passes through an oil type air-cleaner, consisting of a casing, cover, elbow, cap, union and metal packing.

Due to the rotation of air in the air-cleaner large dust particles are thrown onto the oil coated walls, and settle on them. Passing through the metal packing covered with an oil coating the air is completely cleaned and then passes into the carburetor.

A governor *20* of the centrifugal type is installed on the engine. The governor regulates the amount of the working mixture supplied to the cylinders according to the load variations, the engine speed being kept to a uniform number of r.p.m. The governor is rotated by gears on the camshaft.

The engine has combined lubrication system — forced and splash.

Forced lubrication is used for the main and connecting rod bearings, camshaft bearings, rocker-arm bushings, governor shaft bearings, governor coupling and oil pump drive shaft. Splash lubrication is used for the cylinder sleeve, piston, piston pin, connecting rod top end and camshaft cams.

Oil flows to the timing cams and valve gear by gravity.

The clutch shaft, water pump shaft, fan bearing and fan drive shaft are lubricated with grease through oil cups.

Oil is sucked in by pump *16* from crank case *14* through gauge filter *15* and is fed along the pressure pipe through grooves in the crank case to the felt filter *17* and further flows into the main pipe-line drilled along the whole crank case. From the main pipe-line the oil flows through grooves in the transverse walls of the crank case into the main bearings (*8*, *9*, *10*) and then flows along grooves in the crankshaft *6* into the connecting rod bearings. Another portion of the oil passes from the same main pipe-line along the outer groove of the main bearing bushings to other openings in the crank case transverse walls and further to the camshaft bearings; through drilled openings in the shaft journal, in the crank case, head and rear bracket the oil passes into drilled openings in the rocker-arm shaft *18*. From the valve rocker-arm axle the oil passes through openings into the rocker-arm guide.

Then through a groove and a drilled opening in the guide and rocker-arm the oil flows into the longitudinal groove of the rocker-arm, and dripping from the latter it lubricates the ball pin, the pin seat, the end and stem of valve *11*, the adjusting screw and tappet rod *19*. The oil dripping along the stem through drilled openings in the tappet lubricates the cams of the camshaft *12* and the tappet guides. The gears of the governor, crankshaft and camshaft are lubricated by the oil flowing by gravity along the front journal and through drilled openings in the camshaft flange.

The oil pump drive shaft is lubricated by oil flowing from the outer groove of the bushing of the second main bearing *9* through the drilled opening in the middle transverse wall of the crank case.

The checking of the lubrication system is effected by means of the oil level gauge *21* in the crank case and by an oil pressure gauge on the main pipe-line. The rated oil pressure in a warmed engine should be in the range of 1 to 2 kg per sq. cm.

The engine cooling system is mixed — thermo-siphon at the crank case and forced at the cylinder head.

For cooling the water circulating in the engine outer jacket a tubular radiator *22* is employed with a cooling surface of 11 sq. m. The top tank of the radiator is connected by means of a rubber hose with the outer outlet pipe of the cylinder head. The bottom tank of the radiator is connected with the suction union of the outer centrifugal pump *23*, which is fastened to the rear face of the cylinder head by a flange which simultaneously serves as a passage union. During engine operation the pump forces the water into the cylinder head jacket thus increasing water circulation in the cooling system and creating favourable conditions for cooling the hottest engine walls.

For a better cooling of the water flowing through the radiator tubes, a six-vane fan *24* is placed behind it, which together with the pump is rotated by a V-belt from the fan drive shaft.

The working mixture is ignited by a type CC-4 magneto of left rotation with an accelerator.

Magneto *25* is rotated by the governor shaft.

The gap between the magneto breaker contacts should be in the range of 0.3—0.4 mm. The thread diameter of the spark plug *21* is equal to 18 mm ($M18 \times 1.5$). The gap between the spark plug electrodes is in the range of 0.5—0.7 mm.

The engine is started by means of a mechanism consisting of two perpendicular shafts joined by bevel gears. The driven shaft has a sprocket at its end which, during starting, engages the crankshaft sprocket by means of a lever pressing against a button protruding from the casing of the starting mechanism. When the engine reaches the needed speed the chamfers on the sprocket disengage the driven shaft, and is held in disengaged position by a spring on the shaft. The drive shaft is started with a crank.

Transmission. Engine crankshaft rotation is transmitted to the rear drive rolls of the roller by a system of transmission gears. The power train of the transmission of the roller is shown in Fig. 3.

The engine clutch is intended for disconnecting the engine from the power transmission as well as for their smooth connection without jerks.

The engine clutch (Fig. 4) is of the single-disc, dry type with two working surfaces. Linings of pressed asbestos are riveted to the working surfaces of the drive disc.

The clutch is disengaged by means of a lever placed at the right side of the operator.

The expansion coupling (Fig. 5) connecting the clutch shaft with the drive shaft of the reversing gear consists of two

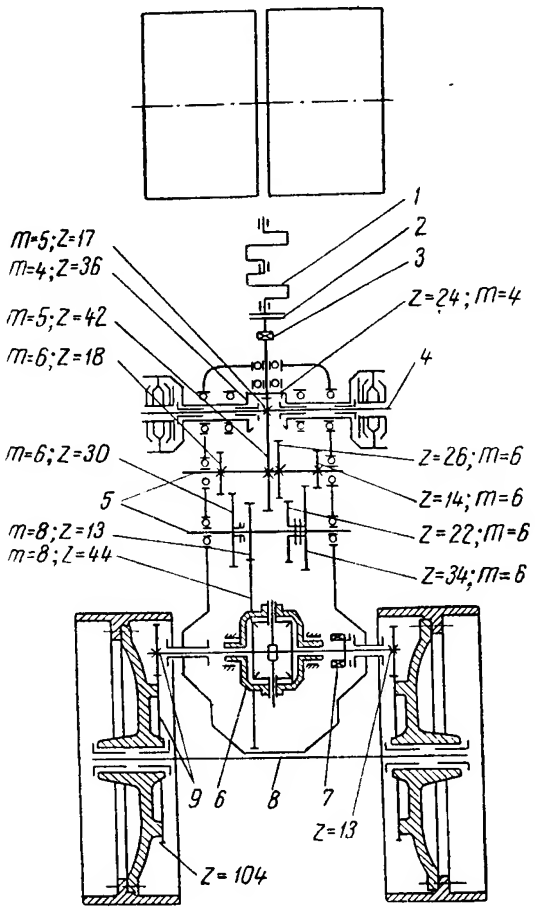

Fig. 3. Operation of Roller

1 Engine; 2. Clutch; 3. Expansion coupling; 4. Reversing gear; 5. Gear box; 6. Differential; 7. Interlock gear; 8. Rear roll axle; 9. Side transmission.

sprockets. Sprocket *2* is rigidly fastened to the drive shaft *4* of the reversing gear, while sprocket *1* is on the clutch shaft *3*. Both sprockets are connected by roller chain *5*.

The expansion coupling is designed for compensating possible insignificant distortions of the shaft axes during engine assembly, of the reversing gear and the gear box on the roller frame.

The reversing gear is intended for the smooth changing of the motion of the roller (Fig. 6).

This gear consists of the following main parts:

1. Drive bevel gear *6* (see Fig. 5).

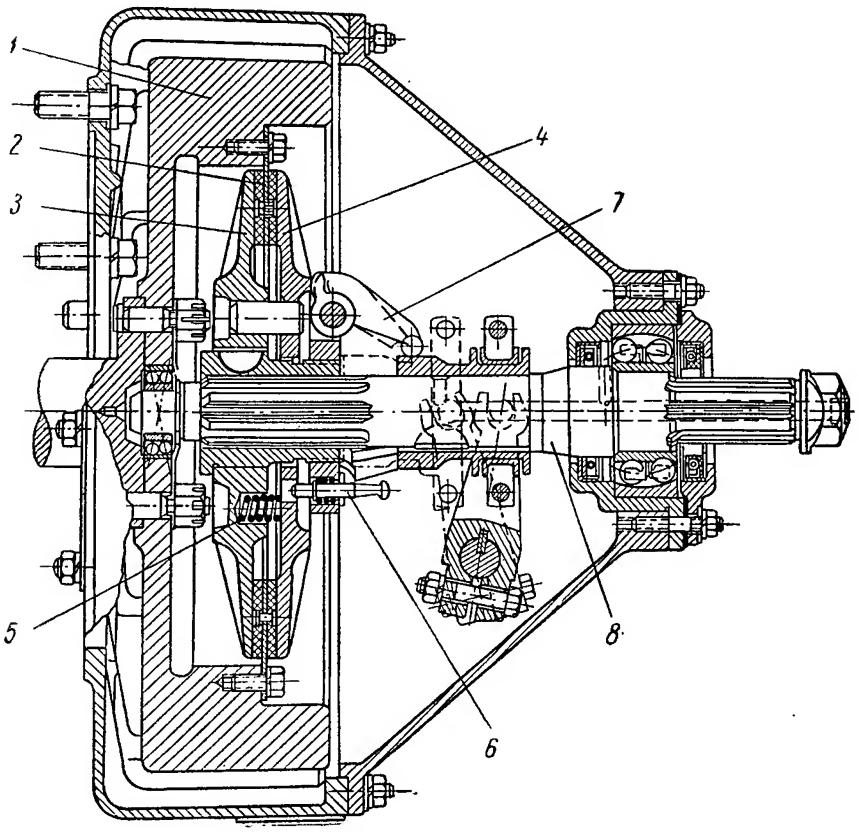

Fig. 4. Clutch

1. Engine flywheel; 2. Clutch drive disc; 3. Front driven disc; 4. Rear driven disc; 5. Driven disc release spring; 6. Index; 7. Pressure lever; 8. Coupling shaft.

2. Two driven bevel gears *1* constantly meshed with the drive gear and, therefore, rotating in different directions.

3. Two friction clutches. The drive discs *2* of these clutches are joined with bevel gears *1*, while driven discs *3* are joined with reversing shaft *4*.

4. The reversing shaft *4* with a spur gear *5* fastened to it transmits rotation to the gear box pinion meshed with the spur gear.

The reversing, i. e. the changing of the direction of the reversing shaft rotation is carried out by means of engaging the corresponding (right or left) friction clutch. This engaging takes place as a result of

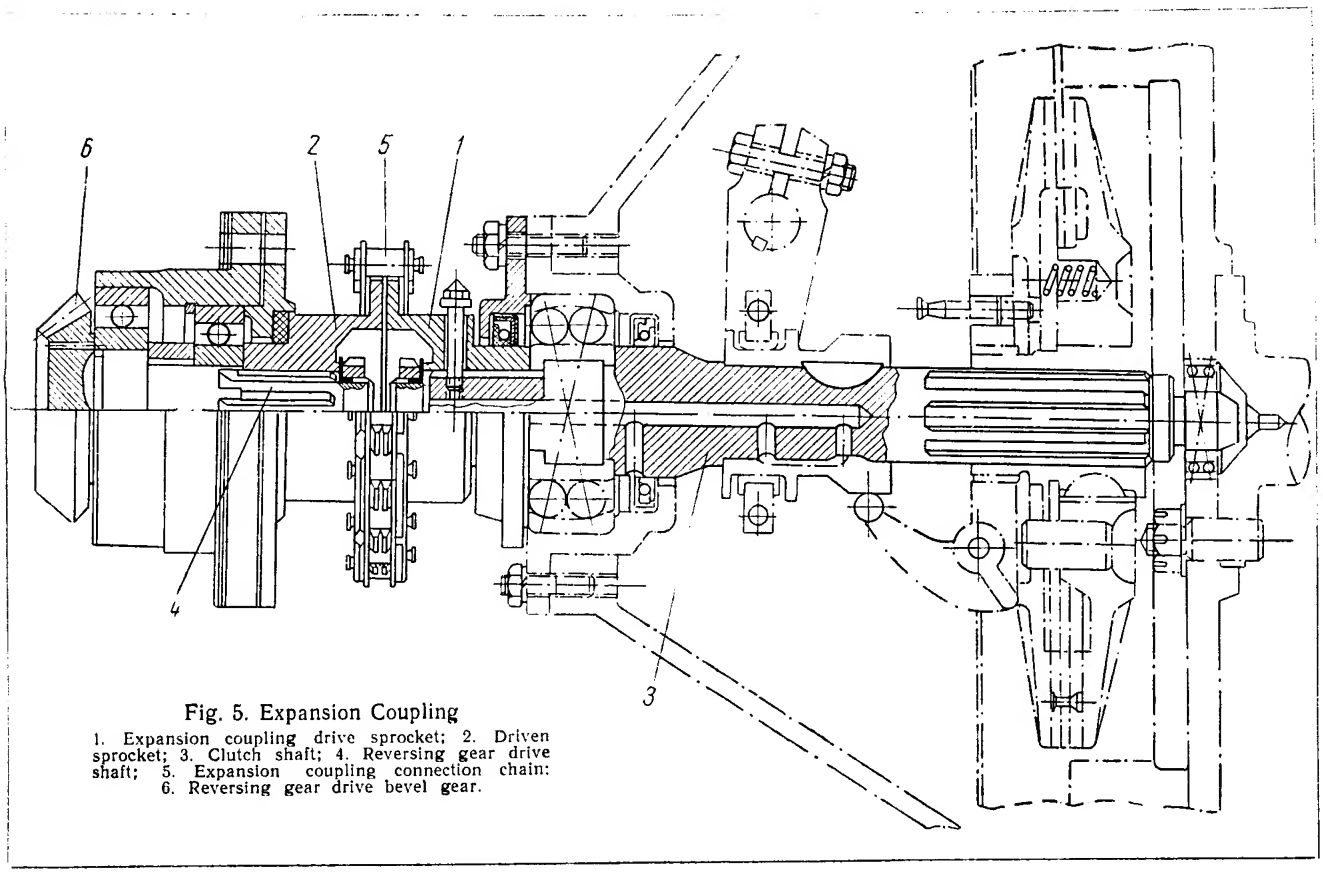

Fig. 5. Expansion Coupling

1. Expansion coupling drive sprocket; 2. Driven sprocket; 3. Clutch shaft; 4. Reversing gear drive shaft; 5. Expansion coupling connection chain; 6. Reversing gear drive bevel gear.

shifting the yoke along the reversing shaft axis, the yoke acting through shackles upon pressure cams *6*, which with their short arms press against the driven disc *4* of the clutch. As a result of this pressure the drive discs *2* of the clutch are clamped by the driven ones and the reversing shaft *4* begins to rotate in the same direction as the level gear with which it is interlocked. For adjusting the distance between

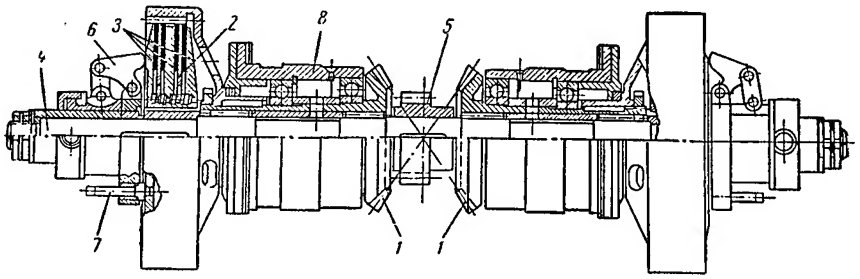

Fig. 6. Reversing Gear

1. Driven gear; 2. Drive discs; 3. Driven discs; 4. Shaft; 5. Spur gear; 6. Pressure cams; 7. Spring index; 8. Bearing housings.

the axes of cams *6* and the clutch discs *3* (necessary in view of the wear of the ferrodo lining on the clutch drive discs), i.e. for the preservation of the needed cam pressure, a movement along the shaft axis is provided for, this being carried out by screwing their supporting crosspiece in the needed direction. For fastening the crosspiece, which has thus been adjusted, there is a spring index *7* installed on the crosspiece in openings of the driven disc of the clutch. Lubricant is supplied to the reversing shaft bearings through special holes in bearing housings *8*. The ball bearings and toothed gears are lubricated by splashing the oil contained in the crank case.

From the reversing gear rotation is transmitted to the gear box which is enclosed in one casing together with the reversing gear and differential. The gear shifting mechanism (Fig. 7) consists of a drive shaft and a driven shaft *2*, a gear *7* on the drive shaft constantly meshed with the reversing shaft gear, of three pairs of gears (*8*, *9*, *10*, *11*, *12*, *13*) which are correspondingly meshed for three travelling speeds of the roller and of gear *14* of the driven shaft which transmits rotation to the differential.

Gears *7, 8, 10, 12* of drive shaft *1* are immovable on the shaft, while gears *9, 11, 13, 14* of the driven shaft *2* may move along the shaft on splines. Both shafts rotate on one side in ball bearings and on the other — in roller bearings.

One end of the driven shaft protrudes from the casing and a brake drum *15* is fixed on it.

The top of the cast iron gear box casing is closed by a cover on which the reversing gear shifting and speed shifting mechanisms are

mounted as well as the filler neck for priming the casing with lubricant is situated.

The first gear corresponding to the lowest travelling speed of the roller is effected when gears *8* and *9* are meshed, the second gear — when gears *12* and *13* are meshed and third (highest speed) — when gears *10* and *11* are engaged.

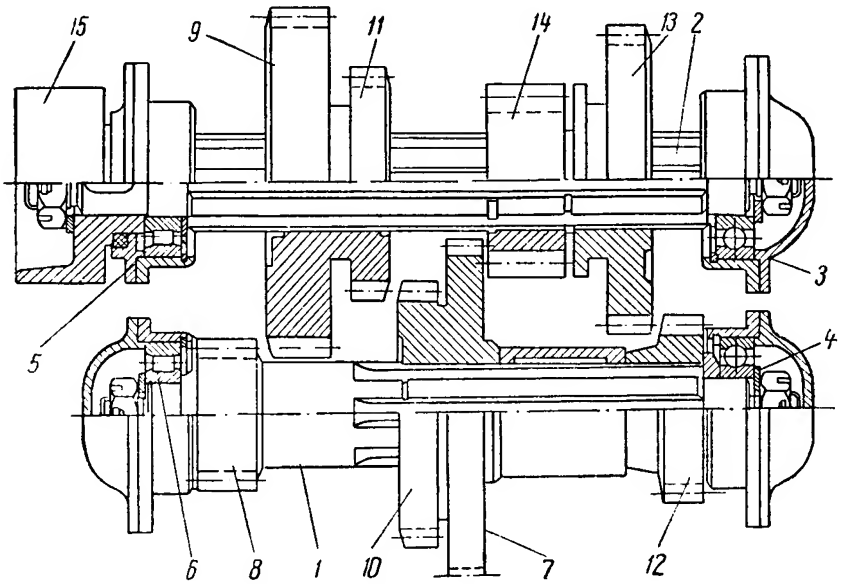

Fig. 7. Gear Shifting Mechanism

1 Drive shaft; 2. Driven shaft; 3.—4. Ball bearings of drive and driven shafts; 5.—6. Roller bearings of drive and driven shafts; 7. to 14. Gears; 15. Brake drum.

The differential (Fig. 8) is situated in the same casing as the gear shifting mechanism. The former serves for allowing the rear rolls of the roller to revolve with various speed when making turns which contributes to decreasing the turning radius of the roller, prevents the shifting of the top layer of the rolled material and lowers the load in the power train of the roller.

The differential consists of six bevel gears enclosed in a casing of two bowls bolted together.

Two axle shaft gears *1* are set on splines of axle shaft *2*, the other four — idlers *3* — are fixed on pins of the crosspiece *4* clamped between the bowls of the casing *5* of the differential.

Casing *5* of the differential on its outer side has a spur gear *6* attached to it by the bolts which fasten together the bowls of the casing. Gear *6* is constantly meshed with spur gear 7 (Fig. 7) of the gear shifting mechanism driven shaft. Along with the rotation of the driven shaft gear rotates the differential casing *5* and together with

the latter revolve the idler gears *3* as their axles are clamped between the bowls of the casing. Idler gears *3* being constantly meshed with axle shaft gears *1*, during rectilinear motion of the roller will turn the axle shafts *2* and further the side gears *7*, thus rotating the rear drive rolls of the roller around their axes (pins *4*). In this case the idler gears will not rotate.

When the roller is turning, i. e. when the outer roll travels a greater distance and therefore rotates faster than the inner roll, the idler gears begin to rotate on their axles and running around axle shaft *1* gears decrease the speed of the inner axle shaft, simultaneously increasing the peripheral speed of the outer axle shaft and outer roll.

During roller travel it frequently happens that rocks get under one of the drive rolls as well as that one of the rolls excessively deepens into the pavement rolled, a factor which results in a sharp increase of resistance against rotation for this roll in comparison with that for the others. The presence of the differential mechanism in this case may cause slipping of the free roll due to insufficient friction and result in the roller not being able to travel on. For preventing this an interlocking of the differential is provided for.

A dog clutch *8* is fixed on the differential axle shaft. By moving the lever toward the operator the clutch is meshed with the claws of the differential casing *5*, achieving in this manner its interlocking, i. e. preventing the possibility of rotation of one axle shaft regarding the other one.

The lubrication of the differential is carried out by the oil in the gear box which passes through holes in the bowls and drips onto the sliding bearings, the idler gears and the axle shaft gears.

The side transmission consists of two pairs of spur gears which pass rotation onto both rear rolls. The small spur gears *7* (see Fig. 8) are fixed on splines of the differential axle shafts and are meshed with large spur gears *3* (Fig. 9) which are bolted to the inner surface of the rear roll hubs.

Compaction rolls include one front and two rear rolls.

The rear rolls of the roller (Fig. 9) are the drive rolls. The rolls are made of cast iron, their rims are removable and are fastened to the hub *2* discs with bolts. Driven gears *3* of the side transmission, made of steel castings, are fastened to the inner side of the hubs.

Both rolls are mounted on a common axle *4* fastened to the roller frame and they both rotate in taper roller bearings. In order to facilitate the adjustment of these bearings as well as to facilitate the assembly and dismantling of rolls the bearings are not set directly on the axis, being set on an intermediate sleeve. This calls for the bearings to be placed into the roll beforehand, hereafter the intermediate sleeve is set and the play of the bearings is adjusted. The roll assembled together with the bearings is mounted on the axle by its sleeve. For dismantling the roll is taken off together with the bearings and sleeve correspondingly. To facilitate the removing of the roll from the axle a special

When receiving a new roller from the Manufacturer's Plant it should be taken into account that the engine has not as yet passed the complete running-in recommended by the engine Manufacturer's Plant. It is therefore necessary during the first 40—50 hours of operation not to load the engine at full horsepower; the roller, therefore, should not be used for the compaction of loose crushed rock, for first passages on asphaltic concrete compaction as well as on other operations connected with high travelling resistance.

Setting the roller into motion. For setting the roller into motion it is necessary to fulfil the following order of operations:

1) to place the transmission shifting lever and reversing shifting lever in neutral position;
2) to release the engine clutch;
3) to install retarded ignition;
4) to place the throttle control lever in central position;
5) to open the fuel tank cock;
6) to close the carburetor choke;
7) to engage the starting gear by pressing with the left hand upon the lever engaging the ratchet;
8) to turn the engine for 2 times for a suction of fuel;
9) to speedily jerk the crank with the right hand upwards, the crank being held in such a way that the thumb be placed on the handle at the palm side; it is prohibited to turn the crank from the top downwards as the engine backfire may cause harmful damage to the operator's hand;
10) when the engine has started to fire set premature ignition and completely open the air throttle;
11) to let the engine after starting operate for some time at no-load at idle low speed so that the thickened oil would reach the bearings and other rubbing parts of the engine;
12) after the engine has been started to engage the engine clutch;
13) to release the brake;
14) to place the gear shift lever in position for the needed speed;
15) for moving roller from place forward or backward to smoothly shift the reversing gear lever forward or backward for setting the roller into motion in either forward or backward direction correspondingly.

Driving of roller. When driving the roller it is necessary to follow the following rules:

1) to shift gears (speed) only with released engine clutch or released reversing gear clutches;

2) to change the direction of roller travel by smooth shifting of reversing gear clutch: it is prohibited to engage the clutch sharply as sharp changing of direction of travel harmfully acts on roller gears and on rolling quality;

3) if the machine or engine manifests any disrepair, they must be immediately stopped and started only after the trouble is eliminated; it is prohibited to repair the machine when the engine is running;

4) rolling during the night should be carried out with the working side illuminated.

Stopping the roller. The complete stopping of the machine at the end of operations is to be fulfilled in the following order:

1) to place the reversing gear clutch and gear (speed) shifting levers in neutral position;

2) to close slowly the throttle and choke, and stop the engine. It is not recommended to stop the engine by closing the choke, as the engine cylinders suck in a large amount of fuel, which leads to the dilution of lubricant and to a speedy wear of parts;

3) to close the cock of the fuel tank;

4) to engage the brake;

5) in cold weather during freezing temperature the water from the engine cooling system must be drained.

MAINTENANCE OF ROLLER

Engine timing system. Normal timing operation depends on the correct clearance between the valves and the rocker-arms; the value of this clearance should not exceed 0.3 mm. A violation of the normal clearance value leads to a loss of engine horsepower and, sometimes, to the damage of valves. The clearance is checked by a clearance gauge every 80—100 hours of operation.

The adjustment of valves is fulfilled as follows: after stopping the warmed engine the breather pipe is disconnected and the cover of the engine cylinder head removed; for clearance adjustment it is necessary to loosen the lock nut of the adjusting screw and by screwing or unscrewing the latter the needed clearance is set by the clearance gauge. After setting the clearance it is necessary to fasten the lock nut reliably and then to check the clearance again by the clearance gauge.

Adjustment is recommended to be carried out successively, beginning with the first cylinders in order to avoid by-passing one of the valves. To avoid mistakes valve clearance is checked with the second valve of the cylinder completely open.

Engine cooling system. The cooling system should be completely filled with water during operation. Considering the losses caused by evaporation it is necessary to check the level of radiator filling several times every shift and to add water as needed.

For the proper operation of the cooling system it is necessary to follow the following rules:

1. To fill the radiator with clean and soft water.

For cooling the engine to use water with 0.24—0.35% of potassium bichromate the presence of which lowers the formation of scaling and prevents corrosion of cooling system parts.

2. To pour in the water only from clean vessels through the filter net in the radiator filler neck.

3. The water level in the radiator should not be below 60—100 mm from the top edge of the filler neck.

4. To observe that the fan belt does not slip during operation. For tensioning the belt it is necessary to unscrew the stop bolt until it passes out of the sheave slit and then, by placing a stop between the cylinder block connecting hose bolt head at the side of the fan drive casing, to turn the fan with one hand on the vane and the other on the belt. The cheek will be screwed on. Turn until the needed belt tension is reached and the stop bolt coincides with the sheave slit. After this lock the stop bolt cheek.

5. No leakage in joints of rubber hoses, unions and through the water pump packing gland is to be tolerated. The taking up of the packing gland is carried out by screwing the packing gland nut with a wrench.

It is not recommended to take up the packing gland more than the amount needed to stop leaks as this may cause a speedy wear of the packing gland and seizing of the water pump shaft.

6. In case water leaks through the control hole in the cylinder block it is necessary to replace the packing gaskets of the sleeve.

7. No soilage of radiator cells is to be allowed, from time to time they must be cleaned.

8. To see that the water in the radiator does not boil.

9. When the engine is overheated no water should be added until it cools as otherwise the water jacket may crack.

10. At least once every season the cooling system must be cleaned of scale with a solution of caustic soda (1 kg of soda and 150 g of kerosene per pail of water). The whole cooling system should be filled with this solution for 8—10 hours; then the engine set into operation for 15—20 minutes, after which the engine is stopped, the solution is drained and the cooling system is filled with clean water, hereafter the engine is started again and warmed and after being stopped the water is drained out. After this clean water for engine operation is poured in.

11. In cold weather after ending operation it is necessary to drain the water from the cooling system; to do this the cocks in the cylinder block and the bottom radiator connecting pipe are opened. If the water is not drained, its freezing may lead to the bursting of the radiator tubes as well as of the cylinder block, cylinder head and water pump.

Engine lubrication system. It is necessary to follow the following rules for the maintenance of the lubrication system:

1. Only clean oil should be poured into the engine crank case.

2. Oil should be poured into the crank case only through the net of the oil filler neck which is situated on the cover of the distributor gear case.

3. Constant watch should be kept on the oil level in the crank case. The oil level should not exceed the top level and in no case should it be below the bottom level on the oil gauge bayonet. If there is excessive

oil in the crank case it jets into the combustion chamber, soils the spark plugs and causes misfiring during engine operation. Oil which jets into the combustion chamber forms carbon deposits and causes the burning of piston leading to speedy wear and to serious damage of the engine. If there is insufficient oil in the crank case the engine becomes overheated, the pistons seize and the bearings may even melt out.

4. The oil in the crank case must be replaced every 40—50 hours of engine operation. The oil should be drained only from a warmed engine by unscrewing the drain plug of the crank case sump and of the felt filter. Then, after screwing in the plug, the crank case should be filled with 3—4 litres of clean oil and the engine made run for 2—3 minutes after which the engine is stopped and the oil is drained.

If thick sludge flows out, the bottom half of the crank case must be removed and rinsed with kerosene.

After rinsing the crank case should be dried, but in no case should it be wiped with waste or rags. Every time the oil is changed it is necessary to rinse the gauge and felt filters of the oil pump. Felt washers should be rinsed in kerosene, pressed out and dried. Then the filter is reassembled, put in place and oil poured up to the top level of the oil gauge. After pouring in oil the engine is started and run for 2—3 minutes in order to have the lubricating system filled with lubricant, hereafter the oil level is checked and, if needed, oil added. The proper operation of the lubrication system is checked by the oil pressure gauge.

Normal oil pressure in a warmed engine should be in the range of 1—2 kg per sq. cm at normal engine speed.

When the engine is insufficiently warmed or when fresh oil is poured into the crank case its pressure may be somewhat higher than the above-mentioned value.

If the engine is sufficiently warmed, an oil pressure exceeding the normal value indicates that the oil grooves are soiled or that the safety valve is seized. In this case it is necessary to remove the crank case sump, take out the safety valve and rinse it. If after this the oil pressure does not decrease to the normal value it is necessary to clean the oil grooves. To clean the oil grooves it is necessary to unscrew the cylinder block main pipe-line, to remove the crankshaft, bushings and to brush the grooves in the cylinder block and crankshaft with a steel or hair brush clean.

An oil pressure below normal shows that the oil leaks from the grooves or that the oil pump gauge filter is soiled, the oil is diluted or the main and connecting rod bearings are greatly worn out.

5. The oil-proofness of all packing must be seen to, not allowing any oil leakage.

The carburetor is intended for preparing the working mixture, i. e. the mixture of air and fuel in certain proportions. This may be attained only in the case when the carburetor is properly adjusted.

For adjusting engine operation at small number of revolutions it is necessary to follow the following:

a) to warm the engine;

b) to turn the throttle lever screw until the engine begins to operate at the smallest number of revolutions; this screw should be loosened to such an extent as to prevent the engine from stopping when the throttle is sharply closed;

c) to turn the idling speed screw until the engine begins to work smoothly and properly without letting off smoke. When the idling speed screw is being loosened the mixture gets less fuel, when tightened it becomes enriched. Usually the proper position of this screw corresponds to $1^3/_4$ turns before complete tightening.

The carburetor is adjusted by the Manufacturer's Plant and usually does not need any changes.

When troubles are detected during the operation of the carburetor they should be immediately eliminated.

The main causes of troubles during operation of the carburetor and methods of their elimination are given below:

1. The fuel leaks from the carburetor due to soiling of the float needle valve; to clean the latter it is necessary to lightly, without undue pressure, lift and lower the float with a finger. If the leaking does not stop it is necessary to unscrew the needle valve and blow through the fuel supply groove.

2. A low amount of fuel in the mixture may be caused by soiled jets, which in this case should be blown through but in no case should they be cleaned with wires, as this changes the calibration of the jets and leads to the enrichment of the mixture and to an increase of fuel consumption.

3. Poor mixtures may also be caused due to soiling of the fuel line and filters. This trouble may be detected by disconnecting the pipe from the carburetor branch pipes. When the pipe-line is soiled the fuel stops flowing out or flows out slowly. In this case it is necessary to rinse the filters and blow through the fuel line.

4. Incorrect fuel supply may be caused by a bent back float. To eliminate this trouble it is necessary to properly set the normal fuel level in the float chamber by means of correctly installing the float.

5. It is necessary from time to time to remove the bottom part of the carburetor and to clean it of accumulated grit.

Air-cleaner. Dust passing together with the air into the air-cleaner settles in the oil, due to which the oil gradually becomes soiled and the air-cleaner stops detaining the dust. This leads to a great amount of dust getting into the engine cylinders causing speedy wear of the cylinders. Therefore every 40—50 hours of engine operation the oil in the air-cleaner hood must be replaced (and when working in very dusty conditions — every 20 hours). It is necessary to watch the oil level in the hood.

The oil is poured in up to the level of the ring belt on the side surface of the stamped hood and up to the beginning of the machined surface of the cast hoods.

For priming the air-cleaner waste oil from the engine crank case is used. Every 150—200 hours of operation it is necessary to rinse the metal packing with kerosene and to soak it in liquid oil.

Ignition system. For reliable engine operation it is necessary to fulfil the following maintenance rules for the ignition system:

1. To check the correctness of installation of the magneto on the engine.

When installing the magneto it is necessary, by using the clearances of bolt setting in fastening holes of the bracket and magneto fastening bolt clearances in bracket holes, to attain such a position that the accelerator fingers and connection disc equally protrude from the grooves of the connection sleeve.

In this case the magneto rotor axle and governor shaft will coincide and the grooves of the connection coupling will not wear out during operation.

With the misalignment of the magneto rotor axle and the governor shaft axis the coupling grooves will wear and the ignition timing will be incorrect.

2. The correct installation of timing must be checked. The installation of timing is fulfilled as follows: the spark plug of the first cylinder is increased and turning the engine with the starting crank the compression stroke is determined by means of closing the spark plug hole with a finger (when the piston moves upward during the compression stroke the pressure in the cylinder is felt by the finger); then mark M3 (ignition moment) on the flywheel is put opposite the lug on the hatch of the crank case flywheel; the screw which fastens the magneto cheek is loosened and the cheek with numbers 1—2 (at the wires) removed and by turning the magneto rotor by the connection coupling counter-clockwise, i. e. opposite the direction of crankshaft rotation, the mark on the magneto distributor gear is placed opposite the mark on the front cover of the magneto. In this position it is necessary to find the coinciding holes in the magneto connection coupling and magneto drive flange and to bolt them together. The ignition in the cylinder will be at 30° before top dead centre.

3. The clearance between the magneto breaker contacts should be periodically checked. The clearance should be 0.3—0.4 mm at the moment of the greatest divergence of contacts. If the clearance differs it should be adjusted by the magneto spanner screwing the long contact screw on the breaker contact-block on or off. After the adjustment of the clearance the screw is fastened with a lock nut and the clearance should again be checked.

4. It must be seen to that the contact surfaces of the breaker be clean and when locked together both surfaces cover each other completely. It is in no case allowed to clean the contact with a rag or glass-paper.

If the surfaces of the contacts are burnt they should be cleaned with a special barette file (needle file).

5. The gap between the spark plug electrodes must be 0.5—0.7 mm.

The gap is measured with a clearance gauge. Gap adjustment may be fulfilled only by means of bending the side electrodes.

6. The electrodes must be timely cleaned of carbon deposits. Carbon deposits are removed with a copper plate or brush and rinsed in benzine.

7. Spark plugs should be carefully unscrewed and with a socket wrench only. It is not allowed to unscrew or tighten the spark plug by means of the insulation nut as this may lead to breaking of the insulation of the core.

8. It should not be tolerated that the wire terminals and spark plug nuts become soiled as this will stop the contacts from working.

9. It must be seen to that every wire leading from the magneto plugs be reliably fastened in the cheeks by stop screws. The stop screw should pass through the insulation and touch the metal core of the wire.

10. The cheek contacts are not to be soiled.

11. Care must be taken that the side distributor cheeks are correctly set and compactly enter into their seats. If the cheek is not in place, the gap between the breaker electrode and cheek electrode will increase and cause incorrect operation of the magneto. The gap between the breaker electrode and cheek electrode should be 0.1—0.2 mm. If the side distributor cheeks do not enter compactly into their places, dust and moisture will get into the magneto causing the magneto to get out of order.

12. It must be seen to that the benzine and oil do not get onto the wires as this damages the rubber insulation of the wire.

Clutch. The clutch tie-rod length should be adjusted in such a manner that when the clutch is engaged the pressure lever ends should completely come out of the cylindrical part of the engagement coupling. The top end of the clutch lever will then be in its right end position. When shifted into the left end position the ends of the pressure levers must completely enter the cylindrical part of the engagement coupling.

When due to soiled disc lining the clutch slips it is prohibited to work as the slipping discs become hot and the lining gets out of order.

As the clutch discs wear the clutch should be adjusted. This calls for:

1) releasing the clutch;
2) removing the hatch cover;
3) pulling off the adjusting nut stop;
4) turning the adjusting nut for compensating the wear of the lining, decreasing the distance between the discs;
5) inserting the stop into one of the nearest holes of the driven disc;
6) putting back the hatch cover in place.

The adjusting nut should not be fastly tightened as this may lead to a damage of the lining.

When the clutch discs are soiled the clutch should be dismantled and the lining should be rinsed with kerosene.

It is necessary to pay attention to the lubrication of the engagement yoke, which is not designed for lengthy operation under load.

In end positions of the clutch pedal the release lever should not press against the yoke, otherwise the yoke and the engagement coupling will become heated and get out of order.

The yoke should be lubricated — with the clutch engaged and the reversing gear released — through the lubricator on the clutch driven shaft chain coupling. In order to distribute the lubricant along the whole surface of the yoke the lubrication should be carried out for several positions of the clutch shaft, for this aim the engine crankshaft is turned by the starting crank.

Reversing gear. The maintenance of the reversing gear consists of timely inspecting, cleaning, lubricating and compensating worn parts.

The normal gear back lash should be about 0.1—0.2 mm. When setting the gears it is necessary to see that the gear faces coincide.

Traces of wear on the gear teeth show whether the gears are in correct position.

In case it should be necessary to move (to compensate wear) the small bevel gear along its axle into some other position, a change of the amount of gaskets situated between the gear box casing and bearing shell flange is sufficient. The large reversing gears are moved in the same way.

When the couplings slip due to wear it is necessary to adjust them, i. e. move the outer friction discs nearer to the inner ones (see description of reversing gear); when they slip due to oiling they should be rinsed with kerosene.

Special attention should be paid to the lubrication of the unit; it is also necessary to check daily the bearing shell nut fastening. In case the antifriction bearings are worn they should be replaced by new ones.

The maintenance of the reversing shifting gear consists of lubricating all of its pivots; it is also necessary to see to it that all bearing bolts are tightly fastened.

Gear box. The gear box should be rinsed with kerosene and primed with lubricant at least once a year.

Before rinsing the gear box it is necessary to preliminarily drain the lubricant through the drain hole in the bottom of the gear box and to fill it with fresh oil through the opening in the cover. The oil level in the gear box should be checked daily with special control rod with marks showing the allowable range of the oil level.

In warm and hot weather it is allowable to fill the gear box with thick oil, for example viscosin grade 5, while in cold weather the oil should be diluted with 50% of automobile oil grade 6. The gear box may contain 17 litres of oil. It is necessary to see that the oil does not leak through the packing gland. Bolts which fasten the gear box to the frame should periodically be checked and taken up.

It is necessary to see that the indexes of the speed shifting mechanism reliably hold the gears in the needed positions; engaged gears should mesh along the whole width of the tooth, while the gap between the faces of the disengaged gears should be from 2 to 4 mm.

Side transmission. The side transmission should be cleaned of dirt and lubricated daily.

Brake. The maintenance of the brake includes its cleaning of dust, dirt and oil.

When the ferrodo lining wears out, it is necessary to move it nearer to the brake drum working surface; this is achieved by tightening the tension screw of the band.

Steering gear. If it is found that the teeth of the worm gear have been normally worn out, it should be removed from the splined end of the swivelling pivot and turned 90° thus bringing into mesh the unworn teeth.

General rules on roller maintenance. Daily, at the end of operations the roller should be carefully cleaned of dust and dirt after which it should be lubricated in accordance with the Lubrication Chart.

Special attention during cleaning of the roller should be paid to the magneto, carburetor and other parts of the engine which should be wiped by a clean, soft rag. The scrapers should be cleaned of adhering dirt.

POSSIBLE DISREPAIRS AND THEIR ELIMINATION

Causes of Troubles	Measures for their Elimination
Engine does not start	
1. Soiled spark plugs (covered by carbon deposits); spark plug contacts broken; spark gap too small; porcelain tube broken	1. Check operation of spark plugs. If needed clean them of carbon deposits and set correct spark gap. Replace rejected spark plugs by new ones
2. Torn wires; damaged insulation; no contact in connections	2. Replace worn out wires. Check wire connections
3. Magneto short-circuiting wire short circuited to body	3. Replace wire or short-circuit device
4. Circuit breaker lever seized	4. Dismantle and check circuit breaker, rinse and lubricate bushing
5. Poor quality benzine or kerosene in fuel tank	5. Replace fuel
6. Air sucked in	6. Check compactness of carburetor connections and intake manifold, take up nuts and, if needed, replace gaskets
7. No fuel in tank	7. Pour fuel into tank
8. No fuel supply to carburetor	8. Check whether cock is open, clean fuel line; check whether there is water in float chamber and whether float needle valve is seized.
9. Incorrect timing	9. Install correct timing
10. Wires mixed up	10. Check timing of spark by cylinders and correctly connect wires to spark plugs
11. Water in cylinders	11. Unscrew spark plugs; if water is present in cylinders then drops of water will be on spark plugs. Take up or replace cylinder head gasket

Continued

Causes of Troubles	Measures for their Elimination
12. Poor compression due to incomplete closing of valves, excessive fuel suction washing oil from cylinder wall or worn rings, piston and cylinders	12. Check correct valve adjustment; pour in some clean oil into cylinders through spark plug holes; replace piston rings
Engine misfires or does not reach full horsepower	
1. Incorrect ignition — poor wires, defective spark plugs or magneto	1. Replace wires, clean wire ends and spark plug clamps, tightly fasten clamp nuts. Inspect spark plugs, clean them and set needed spark gap, check magneto and clean distributor and circuit breaker contacts, adjust gap
2. Water in fuel	2. Clean settling basin, replace fuel by pouring it out of tank and carburetor
3. Valves not resting tightly in seat	3. Clean cylinders of carbon deposits. If needed grind valves
4. Too advanced or retarded ignition	4. Install correct ignition moment
5. Too rich or too poor mixture	5. For poor mixture blow through fuel line, blow through jets and rinse float chamber. For rich mixture clean float needle valve, pack main and compensation jets, rinse air-cleaner, set correct fuel level in float chamber.
6. Air gets into intake pipe-line without passing carburetor	6. Tightly fasten carburetor to intake pipe-line flange or replace jacket
7. Governor out of order	7. Eliminate seizing of governor sleeve
8. Carbon deposits in cylinder	8. Clean cylinder of carbon deposits
9. Worn piston rings	9. Replace piston rings with new ones
10. Water passes through cylinder head gasket	10. Tighten cylinder head. If needed replace gasket
11. Diluted lubricant	11. Replace oil in crank case
12. Fuel of poor quality	12. Drain fuel, rinse tank and fuel line, pour in clean benzine
Backfire in carburetor and silences	
1. Retarded ignition	1. Install needed advanced ignition
2. Missing of ignition in cylinders	2. Check spark plugs, wires and magneto
3. Too rich or too poor mixture	3. Adjust carburetor or replace worn jet
4. Incorrect connection of wires to spark plugs	4. Connect wires properly
5. Incorrect distribution of magneto	5. Install correct magneto distribution
6. Too advanced ignition	6. Decrease advanced ignition
Engine knocks	
1. Too advanced ignition	1. Decrease advanced ignition
2. Carbon deposits in cylinder head and piston face	2. Remove carbon deposits
3. Large clearance in connecting rod bearings of crankshaft	3. Set correct clearance by removal of shims

Continued

Causes of Troubles	Measures for their Elimination
4. Worn sleeve in connecting rod top end	4. Replace sleeve
5. Worn main bearings	5. Replace bushings
6. Worn piston or cylinder	6. Repair engine
7. Large valve clearance	7. Install correct clearance
Large fuel consumption of engine	
1. Too late ignition	1. Increase advanced ignition
2. Too rich mixture	2. Adjust composition of mixture
3. Valves not tight	3. Grind valves
Engine overheated	
1. Too advanced or too late ignition	1. Install correct advanced ignition
2. Too poor or too rich mixture	2. Adjust composition of mixture
3. Insufficient water	3. Add water into radiator
4. Carbon deposits in cylinders	4. Clean cylinders of carbon deposits
5. Scaling in cooling system	5. Remove scaling
6. Loose fan belt	6. Tighten belt
7. Yoke stud or water pump vane stud cut off	7. Replace them
Engine smokes	
1. Too rich mixture (black smoke)	1. Adjust composition of mixture
2. Excessive oil (blue smoke)	2. Remove excessive oil; eliminate burning of piston rings; replace worn piston rings, pistons and sleeves
3. Late ignition	3. Install correct ignition
Clutch does not engage	
1. Incorrect adjustment of clutch lever tie-rod	1. Adjust length of tie-rod
2. Discs do not press together	2. Screw in adjusting screw until discs press together
Clutch not released	
1. Pressure levers come off engagement coupling due to exessive wear of disc lining	1. Replace disc lining
2. Seizing of pressure levers due to wear of seats on engagement coupling surface	2. Replace engagement coupling
3. Seizing of engagement coupling	3. Dismantle coupling, clean, rinse and lubricate working surfaces of clutch shaft and engagement coupling
Clutch slips	
1. Worn drive disc lining	1. Screw on adjusting nut
2. Oiled drive disc lining	2. Rinse lining with kerosene

Continued

Causes of Troubles	Measures for their Elimination
Reversing gear slips	
1. Worn disc lining 2. Oiled disc lining	1. Adjust distance between discs 2. Rinse lining with kerosene
Speed is not shifted	
Disrepaired shifting mechanism (seizing, misalingment, etc.)	Inspect shifting mechanism and repair
Frequent and hard knocks of power transmission	
Broken gear teeth	Dismantle gear box and replace gears with broken teeth
Front roll does not turn	
1. Seizing in worm mesh 2. Damaged worm thrust bearing	1. Repair 2. Damaged bearing to be replaced by new one
Brake does not hold roller on slope	
Worn or loose brake band	Tighten brake band with tension screw

STORAGE AND TRANSPORTATION

After ending operation when the roller is not to be used for a considerable time it is necessary to drain the water and fuel, to carefully clean the machine of dust and dirt, to rinse with kerosene all casings and lubrication holes, to replace worn parts, to adjust and completely lubricate the machine.

It is desirable to store the roller in dry closed premises and only in special cases under a shed with the machine covered with canvas.

Parts which are not painted should be covered with a compact layer of protective compound. Once a year the roller should be painted after preliminarily cleaning all painted surfaces of rust, bubbles, etc.

The roller may be transferred to a distance of 3—4 km by its own motor at 1st, 2nd or 3rd speed depending on the condition of the road.

The transferring of the roller for greater distances and along poor roads should be carried out on trailers to avoid the damage of rolls and roller gears.

It is strictly prohibited to transfer a roller by towing.

SAFETY PRECAUTION RULES

1. The area to be rolled must be illuminated when the roller works at night.

2. It is prohibited to lubricate as well as to eliminate defects and to repair the roller when it is moving.

3. Speeds during movement on slopes should be shifted only when the roller is braked.

4. 1st speed is to be used when turning.

5. The reversing gear couplings should be closed by hoods.

6. During priming of the roller with fuel as well as during operation it is strictly prohibited to smoke on the roller.

7. It is prohibited to start the roller by means of towing.

8. When the engine is overheated the radiator plug should be opened with gloves or rags to prevent scalding by hot water and steam.

9. After operation the roller should be braked.

10. Adjustment of the reversing gear should be carried out with the engine clutch disengaged.

11. When several rollers are working one after another it is necessary for them to have an interval between them of at least 3 m.

12. It is in no case permitted to warm the carburetor and settling basin with an open flame (torch, blow-torch, etc.)

LIST OF SPARE PARTS AND TOOLS DELIVERED WITH ROLLER

Nos.	Designation		Unit	Quantity
	Set of spare parts for Д-211			
1	Pinion gear	НД-11	pc.	1
2	Bushing	Д-260-081-00-003	"	8
3	Friction lining	НД-129	"	8
4	Puller with screw M20×70	НД-512	"	1
	Set of tools Д-211			
1	Wrench for round nuts dia. 45 mm		pc.	1
2	Double-head wrench 17×22		"	1
3	Single-head wrench 55		"	1
4	Wrench for round nuts dia. 78÷85 mm		"	1
5	Ditto dia. 115÷130 mm		"	1
6	Double-head wrench 27×22		"	1
7	Socket wrench 36		"	1
8	Monkey wrench No. 4		"	1
9	Hammer, assembled, No. 7		"	1
10	Mandrel No. 6		"	1
11	Grease-gun		"	1
12	Wrench 14×17		"	1
13	Starting crank		"	1
	Set of spare parts for У5-М engine Individual set of spare parts			
1	Connecting-rod bolt	У5-0314	pc.	1
2	Connecting-rod bolt nut	У5-0315	"	1
3	Connecting-rod bolt nut cotter pin	[illegible]5605	"	1
4	Compression piston ring	У5-0309	"	4
5	Oil piston ring	У5-0311	"	2
6	Cylinder head gasket	У5-0636	"	1
7	Gasket for intake and exhaust manifold	У5-[illegible]	"	1
8	Exhaust pipe gasket	У5-[illegible]	"	1
9	Valve spring	У5-[illegible]	"	2
10	Valve lock	У5-0606	"	4
11	Spark plug	У5-1420	"	2
12	Fan belt	У5-1348	"	1
13	Single set of magneto spare parts according to list of Manufacturer's Plant	БСМ-4к	"	1 set
14	Oil pressure gauge	[illegible]0932	"	1
15	Fastening of oil pump filter housing	У5-0935	"	1
	Tools for У5-М engine			
1	Socket wrench 17×19	У5-4901a	pc.	1
2	Socket wrench 22×26 for spark plugs with extension Ф053	У5-4902	"	1
3	Valve clearance gauge	У5-4904	"	1
4	Wrench 39×42	У5-4905a	"	1
5	Ditto 19×17	У5-4906	"	1
6	Ditto 10×12	У5-4907	"	1
7	Ditto 11×14	У5-4908	"	1
8	Ditto 27×22	У5-4909	"	1
9	Ditto 22×36	У5-4910	"	1
10	Male wrench	У5-49c1	"	1
11	Screw driver	У5-49c2	"	1

№№ п/п.	Обознач. по схеме	Наименование	Электрические данные			Примечание
			тип и группа	номинал	допуск	
1	2	3	4	5	6	7
21	$Л_4$	Осветительная лампа		3,5 в.× ×0,28 а		
22	v	Вольтметр	М-63	3/100 в		
23	С. В.	Селеновый выпрямитель	ВС-45-169			2 штуки
24	Г	Гальванометр				
25	$Т_р$	Трансформатор				
26	БЛОК	Блокировка				
27	$К_1$	Кнопка контрольного милливольта				
28	$К_2$	Кнопка успокоителя				
29	$К_3$	Кнопка вольтметра				
30	$П_1$	Переключатель отведений	4н-5п-IIг			
31	$П_2$	Переключатель напряжения сети				
32	Пр,	Предохранитель				
33	ВКЛ	Выключатель аппарата				
34	„—" „+90"	Анодная батарея	БАС-Г-80-Л-2,1			
35	„—" „+Н"	Аккумулятор накала	2НКН-10			
36	л. н. л. р. п. р.	Провода отведений				
37	земля	Клемма заземления				

Вольтметр (v) служит для проверки напряжения анодной батареи и аккумулятора. При нажатой кнопке ($К_3$) вольтметр показывает анодное напряжение, при ненажатой — напряжение накала. Для подзарядки аккумулятора в аппарате имеется выпрямитель, состоящий из силового трансформатора (Тр) и селенового выпрямителя (С. В.), собранного по двухполупериодной схеме выпрямления. Подзарядка аккумулятора производится при подведении к трансформатору (Тр) напряжения 127 или 220 в. при выключенном аппарате.

В аппарате предусмотрена плавная регулировка усиления от нуля до максимума. Регулировка осуществляется высокоомным потенциометром (R_5), включенным в цепь сетки выходной лампы. Номинальное усиление соответствует среднему положению ручки потенциометра. Для проверки усиления предусмотрена подача на вход усилителя контрольного напряжения в 1 мв. Контрольный милливольт снимается с делителя, состоящего из сопротивлений (R_{12}, R_{13}) и через переключатель, отведений ($П_1$) подается на управляющую сетку лампы СО-243. При ненажатой кнопке ($К_1$) сопротивление делителя (R_{12}) закорочено, поэтому при подаче контрольного милливольта кнопка ($К_1$) должна быть нажата.

Кнопка успокоителя ($К_2$) служит для уменьшения времени установления рабочего режима усилителя при переключениях коммутатора отведений ($П_1$). При нажатии кнопки ($К_2$) или запирании ее путем поворота закорачиваются сеточные сопротивления R_3, R_8 и R_5. В результате этого, на управляющую сетку лампы СО-244 и второго триода лампы СО-243 не будет подаваться изменяющееся во времени напряжение и «зайчик» от гальванометра установится на нулевой линии.

Электродвижущая сила сердца подводится проводами пациента («Пр», «Лр», «Лн») через коммутатор отведений ($П_1$) на сетку лампы СО-243, усиливается тремя каскадами усилителя и воспринимается гальванометром (Г).

Гальванометр (рис. 2) устроен следующим образом. Катушка (1) с сердечником и ярмом (2) составляют электромагнит, в котором создается:

а) постоянное магнитное поле за счет протекания через катушку (1) постоянной составляющей анодного тока выходной лампы усилителя;

б) переменное магнитное поле за счет переменной составляющей анодного тока.

В поле электромагнита помещена металлическая нить (3), выполненная из немагнитного материала. На эту нить прикрепляется железная пластинка с зеркальцем. При отсутствии переменной составляющей анодного тока, а следовательно и переменного магнитного поля, железная пластинка с зеркальцем устанавливается в нейтральном положении. Всякое изменение магнитного поля выводит из

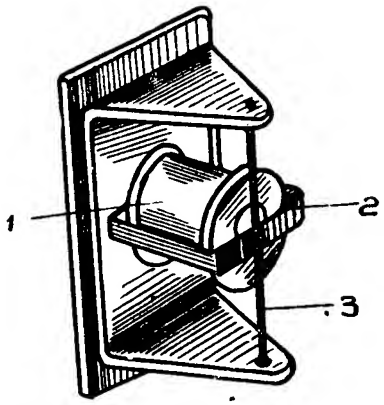

Рис. 2. Гальванометр без кожуха.

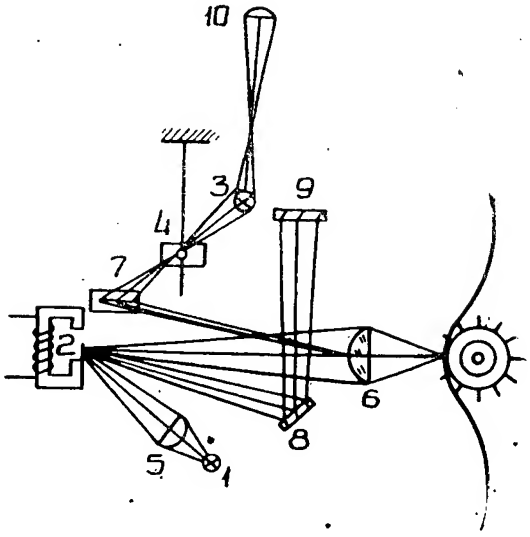

Рис. 3

Оптическая схема аппарата

равновесия железную пластинку с зеркальцем, причем производится скручивание нити (3). В определенных пределах угол поворота зеркальца пропорционален изменению анодного тока выходной лампы усилителя. На зеркальце гальванометра падает луч света от осветителя. В соответствии с поворотом зеркальца меняется положение отраженного от него светового зайчика как на матовом стекле, так и на пленке. С помощью лентопротяжного механизма получаем развернутое изображение элетрокардиограммы на пленке.

2. Осветитель и оптическая система

(см. рис. 3)

В аппарате имеется два осветителя. Один (1) — для посылки светового луча на зеркальце гальванометра (2), другой (3) — для посылки светового луча на отметчик времени (4). В обеих осветителях лампы питаются от аккумулятора (см. рис. 1 $Л_3$ и $Л_4$). Патроны для ламп могут поворачиваться вокруг своей оси и перемещаться вдоль оси тубуса, что необходимо для регулировки положения нити. Тубус осветителя отметчика времени крепится с помощью винтов на плате лентопротяжного механизма.

Осветитель гальванометра имеет оправу с прорезью для прохождения светового луча. Перед прорезью помещается плоско-выпуклая линза (5). Тубус этого осветителя может поворачиваться в горизонтальной и вертикальной плоскостях. Нить лампы (1), освещающей зеркало гальванометра, устанавливается вертикально. Нить лампы (3) отметчика времени устанавливается горизонтально.

Лучи, отраженные от зеркальца гальванометра и от зеркала отметчика времени (7), фокусируются на пленку с помощью линзы (6). Часть луча от гальванометра, отражаясь от наклонного зеркала (8), попадает на стекло для визуального наблюдения (9), и дает возможность контролировать положение «зайчика» на пленке.

Лампа отметчика времени (3) служит одновременно сигнальной лампой. Для этого на тубусе осветителя сделано круглое отверстие. Луч света, проходящий через отверстие, попадает на сигнальный «глазок» (10) и освещает его.

3. Отметчик времени

Отметчик времени состоит из маятника и толкателя, Последний связан с ручкой пуска механизма. При повороте ручки в положение «пуск» маятник освобождается и начинает колебаться.

На грузике маятника имеется отверстие, которое при колебаниях маятника совпадает с отверстием заслонки. Луч, проходящий при

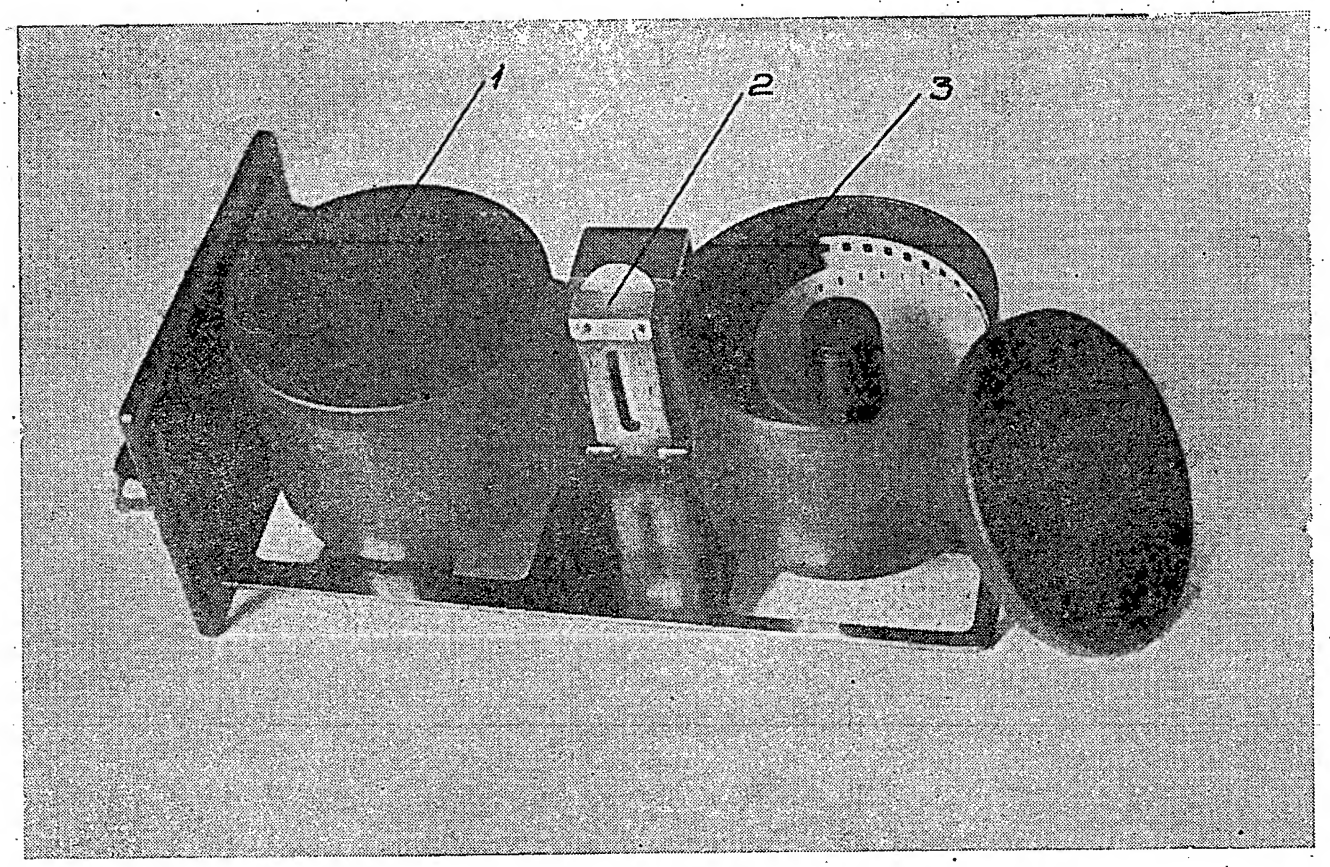

Рис. 4. 1. Зарядная камера. 2. Откидная крышка. 3. Приемная камера.

Рис. 5.

совмещении отверстий, попадает на зеркало (7) и, отражаясь от него, направляется на линзу (6). Последняя фокусирует этот луч в узкую полоску и поперек пленки записывается тонкая линия. Интервал между линиями соответствует $^1/_{20}$ секунды.

Отметчик регулируется так, чтобы луч от зеркала попадал на пленку при среднем неподвижном положении маятника, когда ручка пуска лентопротяжного механизма находится в положении «пуск».

4. Лентопротяжный механизм и кассеты

(см. рис. 4)

Движение пленки производится при помощи специального лентопротяжного механизма. Кассетодержатель соединяется с лентопротяжным механизмом через шестеренки, что дает возможность свободно вынимать и вставлять кассетодержатель в аппарат. В верхней части кассеты (см. рис. 4) находится цилиндрической формы камера (1) для зарядки в нее фотопленки или фотобумаги со светочувствительностью не менее 16 единиц по ГОСТу длиной не более 10 м. Конец пленки, выходящий из верхней камеры, заправляется под откидную крышку (2) тянущего зубчатого барабанчика и проходит в нижнюю камеру (приемную) (3), помеченную красной краской, в которой может поместиться не более 3 м пленки или бумаги.

IV. Конструктивное оформление

Аппарат смонтирован в ящике со съемной крышкой, имеющей ручку для переноски.

На панели управления расположены (см. рис. 5):

1 — выключатель питания;
2 — корректор гальванометра;
3 — ручка «усиление»;
4 — шланг отведений;
5 — переключатель отведений;
6 — вольтметр;
7 — счетчик;
8 — пуск лентопротяжного механизма;
9 — четыре клеммы для подключения внешнего источника питания;
10 — кнопка успокоителя:
11 — сигнальный «глазок»:
12 — кнопка милливольта:
13 — стекло для визуального наблюдения;
14 — ручка кассеты.
15 — клемма заземления.

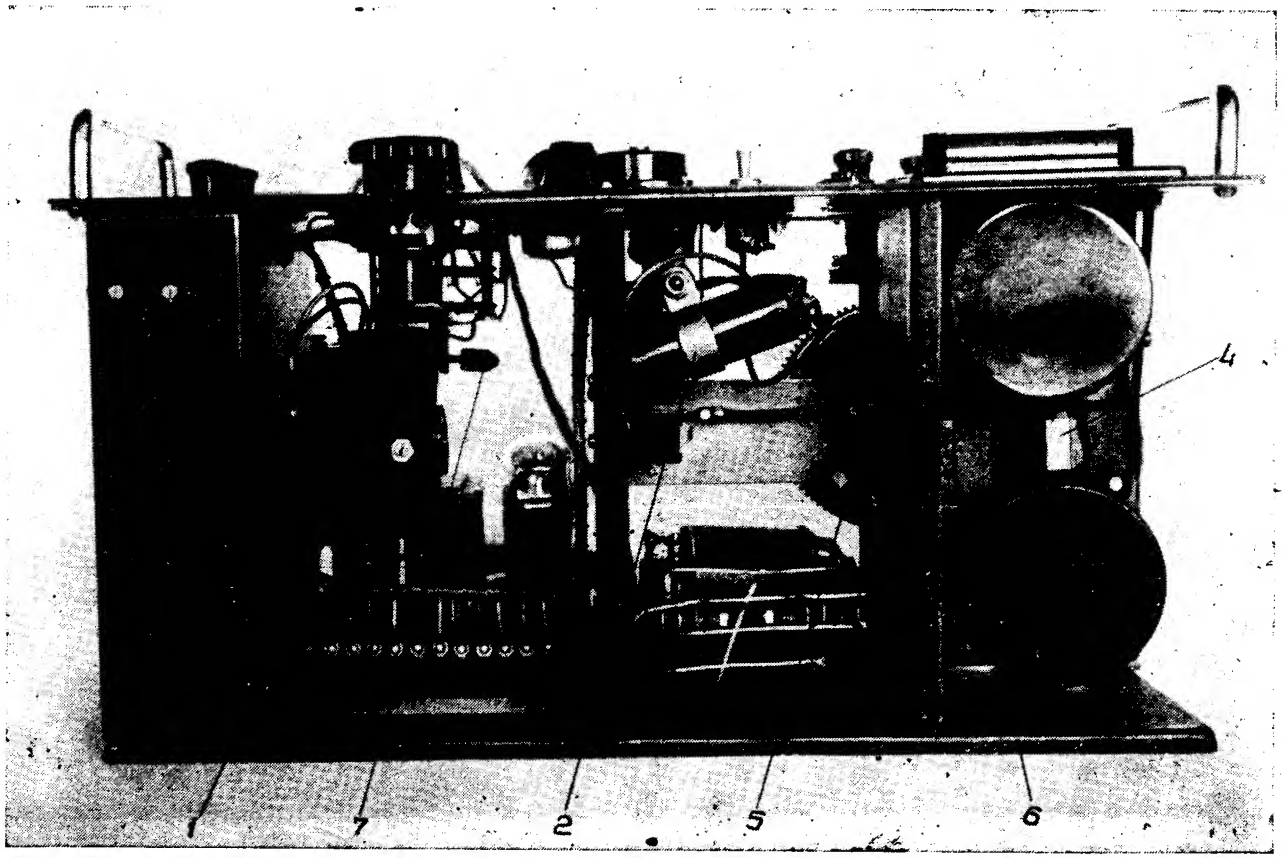

Рис. 6.

1. Гальванометр. 2. Осветитель. 4. Откидная крышка. 5. Зеркало для визуального наблюдения. 6. Линза. 7. Винт для регулировки гальванометра.

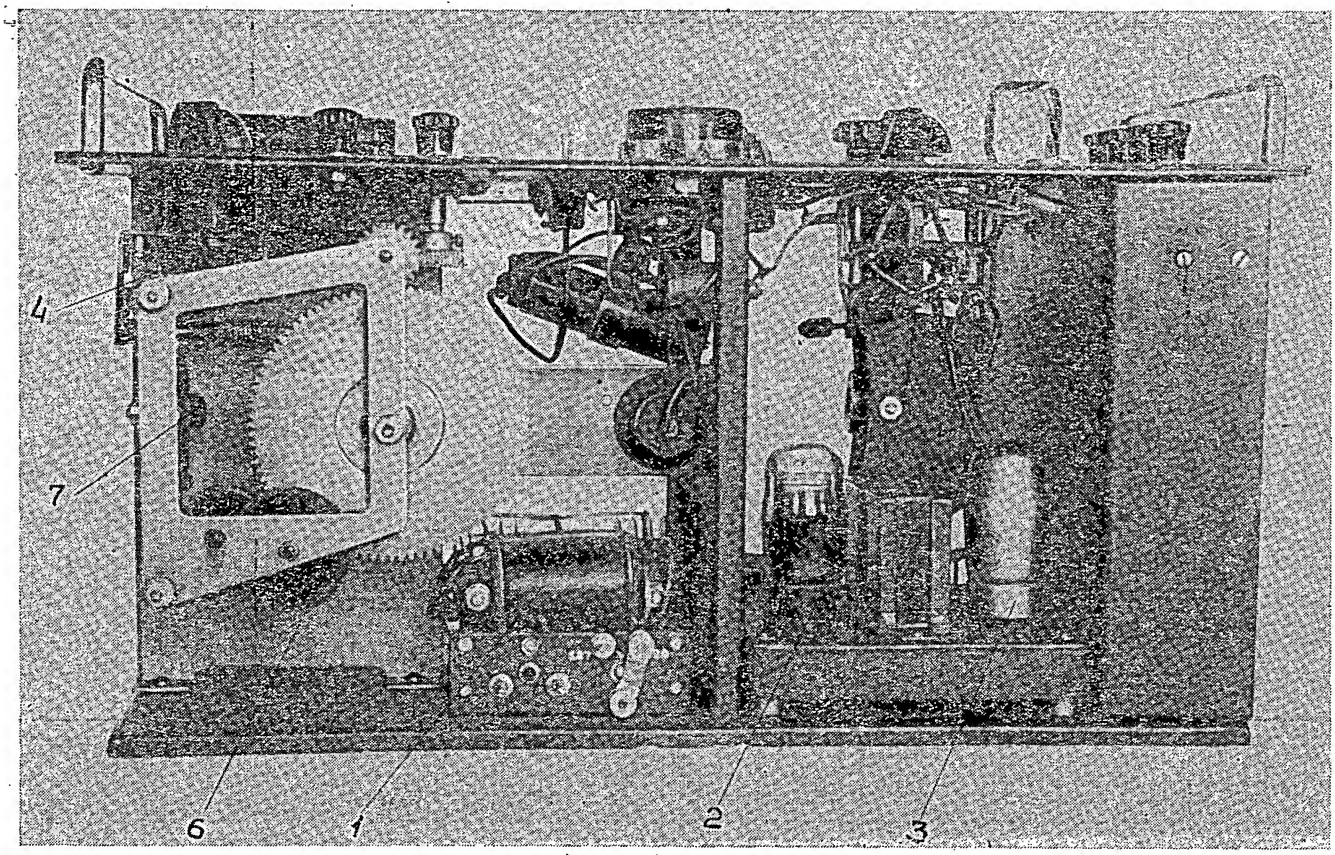

Рис. 7.

1. Трансформатор. 2. Лампа Со-244. 3. Лампа Со-243. 4. Винт с тормозящим фетром. 6. Шестерня с числом оборотов 78. 7. Регулятор скорости.

Шланг пациента присоединен к аппарату постоянно.

Риски проводов соответствуют обозначениям:

правая рука — одна риска;
левая рука — две риски;
левая нога — три риски.

Переключатель отведений имеет четыре положения:

«Б» — положение, при котором проверяется напряжение источников питания.

«0» — установка требуемого усиления;

«I» — первое отведение;

«II» — второе отведение;

«III» — третье отведение;

Пуск лентопротяжного механизма производится поворотом ручки (8) в положение «пуск».

Монтаж аппарата приведен на рис. 6 и 7.

V. Инструкция пользования

1. Установка электрокардиографа.

Нормальная работа электрокардиографа во многом зависит от правильного выбора помещения для его установки.

Электрокардиограф должен находиться в изолированной комнате, отдаленной от рентгеновского и физиотерапевтического кабинетов. Вблизи электрокардиографического кабинета не должны располагаться силовые и осветительные провода сети. Нежелательно ставить аппарат в помещения, выходящие в сторону прохождения трамвайного или троллейбусного кабелей.

При работе с электрокардиографом его следует присоединять при помощи провода заземления к шинам заземления, а если их нет в помещении, то провод заземления можно подсоединить к зачищенной от краски водопроводной трубе.

Не разрешается подсоединять заземляющий провод к трубам, в которых идут электрические провода.

2. Укладывание пациента

Во избежание влияния сокращений мускулатуры тела, лучше снимать электрокардиограмму при полном покое пациента и расслаблении всех мышц тела. Пациент должен спокойно лежать на кушетке с протянутыми вдоль тела руками, при этом дыхание должно быть ровным.

3. Подготовка аппарата к работе

1. Перед каждым включением аппарата необходимо проверить, чтобы все ручки управления находились в исходном положении: выключатель аппарата — в положении «выкл», ручка переключателя отведений — в положении «Б», ручка регулировки усиления — в положении «О», ручка лентопротяжного механизма — в положении «стоп».

2. Подключить к клеммам «—» «+80» и «+90» батарею БАС-Г-80.

3. К клемме «земля» присоединить заземляющий провод. Другой конец этого провода присоединить к заземляющей шине или к зачищенной части водопроводной трубы.

4. С помощью специальной ручки, которая хранится на внутренней стороне крышки ящика, завести пружину лентопротяжного механизма (через отверстие в правой стенке корпуса).

5. Зарядить верхнюю камеру, а конец пленки пропустить в нижнюю (приемную) камеру. После этого вставить кассету на место в аппарат.

6. Выключатель аппарата поставить в положение «вкл». Проверить анодное напряжение и напряжение накала. При измерении анодного напряжения необходимо нажать кнопку вольтметра. Нормальное анодное напряжение составляет 80 ÷ 90 в. (показания стрелки прибора в пределах черной черты); нормальное напряжение накала — 2,4 ÷ 2,6 в (стрелка прибора в пределах красной черты). Если напряжение накала ниже указанного, нужно подзарядить аккумулятор. В случае заниженного анодного напряжения необходимо сменить батарею БАС-Г-80.

7. Ручку переключателя отведений перевести в положение «О» и с помощью корректора установить «зайчик» в середине визуального стекла. Далее, поворачивая ручку регулятора усиления по часовой стрелке и нажимая на кнопку милливольта, установить такое усиление, при котором «зайчик» отклонится на 10 мм при подаче контрольного милливольта (при нормальной работе усилителя это соответствует 3—4 делению).

8. Выключатель аппарата поставить в положение «выкл».

Примечание: Для проверки проводов пациента на обрыв рекомендуется подавать контрольный милливольт на каждом из отведений. Для этого на I-ом отведении нужно замкнуть провода, отмеченные одной и двумя рисками, на II отведении — провода с одной и тремя рисками, на III отведении — провода с двумя и тремя рисками.

Внимание!

Перед пуском в эксплуатацию вновь полученного аппарата необходимо произвести зарядку аккумулятора 2НКН-10, залив

предварительно его электролитом. Аккумулятор находится внутри аппарата. Для того, чтобы вынуть его, нужно открыть левую стенку ящика (рис. 8).

4. Съемка электрокардиограммы

1. Обернуть электроды тонкой материей или бинтом, смоченным физиологическим раствором, затем наложить их на руки не выше локтя и на левую ногу пациента. Предварительно кожу пациента необходимо протереть спиртом для обезжиривания. Для обеспечения надежного контакта с телом электроды прижать резиновыми бинтами. Вилки шланга пациента включить соответственно рискам: правая рука — одна риска, левая рука — две риски, левая нога — три риски. Для грудных отведений к аппарату прикладывается специальный круглый электрод с эбонитовой ручкой.

2. Включить аппарат и через 1—2 минуты после включения при установленной чувствительности заснять милливольт. Для этого при нулевом положении переключателя отведений повернуть ручку лентопротяжного механизма в положение «пуск», несколько раз с интервалом нажать на кнопку милливольта и остановить механизм.

3. Поставить переключатель отведений на 1-е положение. Нажать на кнопку успокоителя. Когда «зайчик» вернется на середину стекла для визуального наблюдения произвести съемку первого отведения. (Если «зайчик» не возвратится на середину стекла, то корректором поставить его в это положение).

4. После съемки первого отведения остановить механизм, поставить переключатель пациента на II-е положение и заснять второе отведение. Таким же путем снимается третье отведение.

Для снятия грудного отведения необходимо электрод с левой ноги поместить на наружный край сердечного толчка. Если место толчка не определяется, то электрод помещается в 5-е межреберье снаружи от сердечной тупости. При этом в качестве индиферентного электрода служит правая рука.

На время переключения электрода, во избежание порчи гальванометра, следует поставить ручку отведений в положение II и запереть кнопку успокоителя. Для этого надо нажать кнопку и в нажатом состоянии пальцем повернуть ее по направлению хода часовой стрелки. Отпирание ее производится в обратном порядке. При снятии других грудных (см. рис. 9) отведений нужно в промежутках между снятием запирать кнопку успокоителя.

5. Проявление пленки

Для аппарата «ЭКП-4м» применяется фотопленка от аппарата ФЭД ортохром, но может быть использована и кинопленка изопан-

хром или панхром, а также перфорированная фотобумага. (Ширина пленки — 36 мм.).

Светочувствительность любой электрокардиографической бумаги должна быть не менее 16 единиц по ГОСТу.

Зарядка и проявление должны производиться в темной комнате («ортохром» и фотобумага могут обрабатываться при красном свете). При проявлении пленку свертывают вместе с корректором. Проявляют в течение 5—15 мин., в зависимости от свежести и состава проявителя. Фиксирование ведется до тех пор, пока пленка не станет прозрачной, после чего лента промывается в чистой воде и высушивается.

Примерный рецепт проявителя для бумаги или пленки следующий: На литр дистиллированной воды при 20° С растворяют метола — 5 грамм, гидрохинона — 10 грамм, сульфита — 40 грамм, соды безводной — 34 грамма, бромистого калия — 3 грамма.

Фиксаж: на 1 литр дистиллированной воды растворяют тиосульфата натрия (гипосульфит) — 250 грамм.

VI. Уход за аппаратом и регулировка основных его узлов

1. Краткая инструкция по уходу за аккумуляторной батареей.

Аккумулятор аппарата отформован на заводе, но электролит из него вылит (с целью безопасности транспортировки аппарата); поэтому перед тем, как пустить аппарат, нужно аккумулятор залить электролитом и зарядить. Электролитом служит раствор едкого натрия или едкого калия в дистиллированной воде (можно пользоваться дождевой водой, собранной с чистой поверхности, или водой полученной при таянии снега).

Раствор готовится так:

1. Для приготовления электролита из твердых щелочей берется приблизительно:

а) для получения раствора едкого натрия плотностью 1,17—1,19 одна весовая часть твердого едкого натрия на четыре весовых части воды;

б) для получения раствора едкого калия плотностью 1,19—1,21 одна весовая часть твердого едкого калия на три весовых части воды

2. Взвешенное количество щелочи помещается в посуду (посуда должна быть стеклянной, чистой железной, чугунной или керамической) и заливается необходимым количеством воды. Для ускоре-

ния растворения щелочи воду перемешивают стеклянной или железной палочкой.

3. Остывший раствор щелочи доводят до требуемой плотности по ареометру, добавляя воду или твердую щелочь при перемешивании. Требуемая плотность:

а) для едкого натрия — 1,17 ÷ 1,19.

б) для едкого калия — 1,19 ÷ 1,21.

4. Приготовленному раствору дают отстояться, затем осторожно заливают аккумуляторы и оставляют на 2 часа для пропитки. Уровень электролита над пластинкой аккумулятора должен быть не менее 5 мм и не более 12 мм.

Уровень определяется стеклянной трубкой, которая опускается в аккумулятор до пластин, затем, плотно закрыв пальцем верхний конец трубки, вынимают ее из аккумулятора. Высота столбика электролита в трубке будет такой же, как высота электролита над пластинами аккумулятора.

5. В каждый аккумулятор после заливки электролита вливают до 10 капель вазелинового масла.

2. Зарядка аккумулятора

1. Первичную зарядку аккумулятора желательно производить вне аппарата на зарядной станции, ибо селеновый выпрямитель, вмонтированный в аппарат, не обеспечивает 8-часовую зарядку (нормальный 8-часовой зарядный ток для 2НКН-10 равен 2,5 амперам).

2. Если нет зарядной станции, то первичную зарядку можно произвести в аппарате, но продолжительность зарядки при этом нужно увеличить до 10 ÷ 11 часов. Такую зарядку нужно давать, вынув аккумулятор из ящика и открыв пробки. Последующие зарядки можно давать в виде подзарядок в течение 3 ÷ 4 часов.

3. При нерегулярной эксплуатации один раз в месяц необходимо производить усиленный заряд. Усиленный заряд производится в течение 6 часов нормальным током (2,5 а) и 6 часов силой тока, равной половине нормального (1,25 а).

4. Если аккумуляторы работают круглый год в неизменных температурных условиях, то смена электролита производится не реже одного раза в год. Если емкость аккумулятора заметно снижается, то электролит необходимо сменить ранее указанного срока. После смены электролита дается усиленный заряд аккумулятора.

3. Регулировка оптической системы

Оптическая система электрокардиографа включает оптическую систему отметчика времени и оптическую систему гальванометра, каждая из которых настраивается отдельно.

Необходимость регулировки оптической системы может возникнуть при смене осветительных ламп или же после сотрясений, полученных аппаратом при неправильной его транспортировке.

В том случае, когда на пленке получается широкая, расплывчатая линия отметки времени или же она отсутствует, следует отрегулировать оптическую систему отметчика времени.

Регулировка производится следующим образом: маятник устанавливается так, чтобы отверстие на его пружине с грузиком совпало с отверстием на заслонке. Луч света, проходящий при совмещении отверстий, падает на зеркало. Последнее нужно расположить так, чтобы обеспечить попадание луча на линзу 6 (рис. 6). Нить лампы осветителя должна быть в горизонтальном положении. Это достигается поворотом оправы с патроном вокруг своей оси. Правильность положения нити наблюдается на бумаге, расположенной на диафрагме перед линзой (6). После линзы световая полоска фокусируется на пленке в виде тонкой горизонтальной полоски. Точная фокусировка достигается перемещением лампы осветителя вдоль тубуса.

В том случае, когда на пленке получается расплывчатая с подсветом запись электрокардиограммы, следует отрегулировать оптическую систему гальванометра.

Регулировка производится следующим образом: световой луч осветителя (2) (рис. 6) направляется на зеркальце гальванометра. Поместив бумагу перед линзой (6) обнаруживают «зайчик» и, регулируя осветителем и винтом гальванометра, направляют его на плоско-выпуклую линзу в виде вертикальной черты, которая линзой (6) собирается в яркую точку на пленке.

Следует учесть, что нижняя часть «зайчика» должна захватывать наклонное зеркало (3) и после отражения попадать на стекло для визуального наблюдения. Так как линза окошка гальванометра дает также отраженный луч, то не следует его смешивать с «зайчиком» гальванометра. Отличить его можно тем, что с удалением от гальванометра он расплывается в широкую полосу. Поворотом гальванометра его следует отнести в сторону, иначе пленка будет затемняться. Чтобы на пленке получилась точно отфокусированная точка необходимо, чтобы «зайчик» попадал на линзу строго вертикально. Это достигается поворотом патрона осветителя (2) с лампой. Этим поворотом толщина линии на пленке может быть сделана любого размера.

4. Ремонт и регулировка гальванометра

Вскрывать гальванометр можно только в исключительных случаях.

Необходимость в ремонте и регулировке гальванометра возникает при обрыве нити или тогда, когда отклеится зеркальце. Это легко можно проверить, рассматривая нить через линзу гальванометра.

Новая нить натягивается между латунной втулкой и регулируемым с помощью винта сухариком.

Плоскость нити обязательно должна быть параллельна основанию скобы. Скручивание нити не допускается. На нить наклеивается шеллачным лаком пластинка из железа «Армко» размером $0{,}05 \times 1 \times 4$ мм и зеркальце из оптического стекла размером $0{,}05 \times 0{,}7 \times 2$ мм. Для большей устойчивости нужно железную пластину наклеивать снизу, а зеркальце сверху нити. После наклейки нужно дать сохнуть не менее 10 часов Регулировка чувствительности производится после сушки. Нить натягивается с помощью винта, перемещающего сухарик. После этого, перемещая сердечник, добиться, чтобы зеркальце установилось с одного края сердечника, иначе будет малая чувствительность гальванометра. Проверка чувствительности производится только в аппарате подачей милливольта на 3-й ступени усиления. Одновременно по «зайчику» заметить не дает ли зеркальце двойного изображения или каких-либо подсветов.

5. Регулировка лентопротяжного механизма

Регулировка лентопротяжного механизма производится в тех случаях, когда интервал между отметками времени на пленке больше или меньше 1,8 ÷ 2 мм. Регулировка производится с помощью винта с мягким тормозящим фетром (4) на конце (см. рис. 7). При вращении фетр упирается в диск, укрепленный на оси регулятора. (5). Приближая и удаляя винт от диска, можно получить нужное число оборотов, которое соответствует 78 об/мин. валика, ведущего к кассете. В этом случае скорость прохождения пленки будет 38 мм/сек., а интервалы между отметками времени будут порядка 1,9 мм. Обороты нужно считать по секундомеру. Для удобства отсчета следует на валике сделать пометку цветным карандашом. После регулировки винт (4) затягивается контргайкой.

VII. Возможные неисправности и их устранение

Неисправность	Возможная причина	Способ устранения
1	2	3
1. Аппарат включен, но «зайчик» не появляется на визуальном стекле	1. а) Нет накала или накал недостаточен	а) Проверить вольтметром напряжение накала и, в случае необходимости, зарядить аккумулятор
	б) Перегорела лампа осветителя или вывернулась из патрона	б) Ввернуть в патрон или заменить исправной
	в) Нарушилась фокусировка оптической системы гальванометра	в) Вынуть аппарат из ящика и отфокусировать
2. Нет чувствительности при любом положении регулятора усиления (при нажатии на кнопку милливольта «зайчик» не отклоняется от нулевого положения)	2. а) Вышла из строя анодная батарея	2. а) Сменить анодную батарею
	б) Перегорела одна из ламп усилителя	б) Сменить лампы
3. «Зайчик» на визуальном стекле дает мелкую дрожь	3. Плохой контакт электродов с пациентом	3. Проверить контакт электродов с кожей пациента. Увлажнить ткань на электродах
4. На пленке нет отметки времени	4. а) Сгорела лампа осветителя отметчика времени	4. а) Сменить лампу
	б) Нарушилась фокусировка отметчика времени	б) Отфокусировать
5. Отметки времени очень часты или слишком редки	5. Разрегулировался лентопротяжный механизм	5. Отрегулировать
6. При подаче усиления зайчик на визуальном стекле колеблется	6. Израсходовалась или высохла анодная батарея	6. Заменить новой

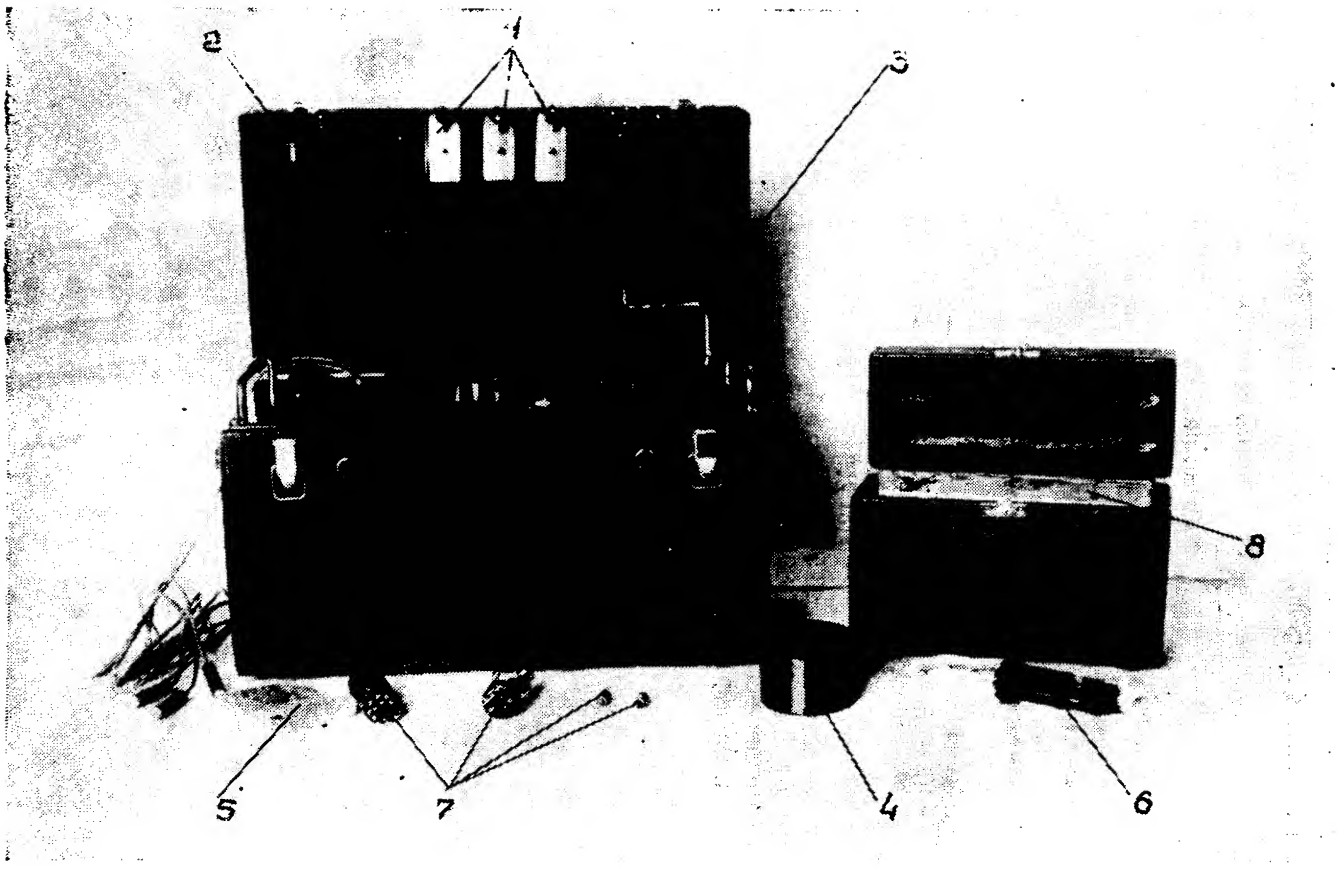

Рис. 8.

Устранение всех других неисправностей может производиться только квалифицированным специалистом или в мастерских.

VIII. Комплектность

(см. рис. 8)

В комплект аппарата входят:

1) электроды 30 × 60	— 3 шт.
2) электрод грудной	— 1 шт.
3) ручка заводная	— 1 шт.
4) запасная приемная камера	— 1 шт.
5) бинт резиновый	— 3 шт.
6) шнур сетевой	— 1 шт.
7) провод заземления	— 1 шт.
8) запасной комплект ламп:	
СО-244	— 1 шт.
СО-243	— 1 шт.
осветительные 3,5 в.×0,28 а	— 2 шт.
9) батарея БАС-Г-80 в чемодане	— 1 шт.
10) техническое описание, инструкция по эксплуатации и паспорт аппарата.	